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"OCCURRENCE OF GIARDIA IN CONNECTICUT WATER SUPPLIES AND WATERSHED ANIMALS"

by

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Contract No. 68-03-2687

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Preventable Diseases Division and Laboratory Division
of the Connecticut State Department of Health Services

Health Effects Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

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16. ABSTRACT

The main objective of this research was to study the occurrence of Giardia in selected water supplies and watershed animals in Connecticut.

Water samples were collected monthly using the E.P.A. approved Giardia sampling method at selected water utilities and analyzed for Giardia cysts. With every Giardia sample collected, samples were tested for: total coliform, fecal coliform, standard plate count, yeast, turbidity, and pH.

Fecal specimens were collected then analyzed from beaver, deer, squirrel, muskrat and raccoon if these animals were found on the watershed. A written description of the watersheds involved in this study is included.

Attempts to correlate the presence of Giardia cysts with the collected water quality data were not successful because Giardia cysts were not found on the E.P.A. approved sampling filters.

Six out of 413 animal fecal samples were found to be positive for Giardia from samples collected on the reservoir watershed. Collection of fecal samples from trapped animals yielded a slightly higher percent positivity than fecal samples collected from live animal droppings.

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FOREWORD

The many benefits of our modern, developing, industrial society are accompanied by certain hazards. Careful assessment of the relative risk of existing and new man-made environmental hazards is necessary for the establishment of sound regulatory policy. These regulations serve to enhance the quality of our environment in order to promote the public health and welfare and the productive capacity of our Nation's population.

The complexities of environmental problems originate in the deep interdependent relationships between the various physical and biological segments of man's natural and social world. Solutions to these environmental problems require an integrated program of research and development using input from a number of disciplines. The Health Effects Research Laboratory, Research Triangle Park, NC and Cincinnati, OH, conducts a coordinated environmental health research program in toxicology, epidemiology, and clinical studies using human volunteer subjects. Wide ranges of pollutants known or suspected to cause health problems are studied. The research focuses on air pollutants, water pollutants, toxic substances, hazardous wastes, pesticides, and nonionizing radiation. The laboratory participates in the development and revision of air and water quality criteria and health assessment documents on pollutants for which regulatory actions are being considered. Direct support to the regulatory function of the Agency is provided in the form of expert testimony and preparation of affidavits as well as expert advice to the Administrator to assure the adequacy of environmental regulatory decisions involving the protection of the health and welfare of all U.S. inhabitants.

This report provides information on the occurrence of Giardia in selected water supplies and watershed animals in Connecticut. The results of this study indicated Giardia was absent in source and drinking water when examined. Only six (4 muskrat and 2 raccoon) of 413 animal fecal specimens were positive for Giardia. Relationships could not be established between presence of Giardia in water and customary indicators and yeasts.

F. Gordon Hueter, Ph.D.
Director
Health Effects Research Laboratory

ABSTRACT

The main objective of this research was to study the occurrence of Giardia in the selected water supplies and watershed animals in Connecticut.

Water samples were collected monthly using the EPA approved Giardia sampling method at selected water utilities and analyzed for Giardia cysts. With every Giardia sample collected, samples were analyzed for: total coliform, fecal coliform, standard plate count, yeast, turbidity, and pH.

Fecal specimens were collected and then analyzed from beaver, deer, squirrel, muskrat and raccoon if these animals were found on the watershed. A written description of the watersheds involved in this study is included. This description includes size, type, recreational use, human inhabitation, historical water quality data, known sources of contamination, efforts used to protect the watershed, species and population estimates of the watershed animals.

Because Giardia cysts were not found using the EPA sampling filters, no attempt could be made to correlate the presence of Giardia cysts with water quality data.

Four muskrat (Ondatra zibethicus) and two racoon (Procyon lotor) out of 413 animal fecal samples were found to be positive for Giardia from samples collected on the reservoir watersheds. Although 48 beaver (Castor canadensis) fecal specimens were examined, none were positive for Giardia. Collection of fecal samples from trapped animals yielded higher percent positivity than fecal samples collected from live animal droppings.

This report is submitted in fulfillment of Contract No. 68-03-2687 by the Connecticut State Department of Health under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period October 1979 to October 1980, and work was completed as of April 1, 1981.

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Mr. Theadore Ericksen, Project Officer, Field Studies Division, EPA, provided valuable guidance throughout the project. The guidance and supervision of Ray Jarema, Principal Sanitary Engineer and Richard Woodhull, Chief of Water Supplies is gratefully acknowledged. The cooperation of the representatives of the water utilities involved in the study is appreciated. The cooperation of the trappers who provided the animal fecal specimens was essential.

SECTION 1

INTRODUCTION

Giardia lamblia was the most commonly identified pathogenic parasite in the United States in 1978, being found in 3.9% of all stool specimens examined by state and territorial public health laboratories. The Giardia positivity range was 1.1-16.7% (1). Recent waterborne outbreaks have suggested the possibility of cross-transmission from one mammalian species to another for Giardia (2,3,9). In one outbreak (8) a well operated, filtered water supply was implicated in a waterborne epidemic of giardiasis despite producing excellent quality finished water as normally evaluated. The largest waterborne outbreak (11) of giardiasis occurred in Rome, New York, from November 1974 to June 1975 in which 350 residents had laboratory confirmed giardiasis. An epidemiologic study estimated that approximately 4,800 individuals were affected during the outbreak. It is well documented that a number of mammalian species can carry Giardia. Wildlife stool surveys were conducted in the State of Washington during four consecutive trapping seasons, 1976 to 1980, to determine the prevalence of Giardia in wildlife species. Only muskrat and beaver were found to be positive for Giardia (4).

In a comparative study of Giardia spp. in small mammals in southern Ontario, live trapped deer mice, voles and the wild rat were found to be infected with Giardia spp. (5).

Because of the waterborne outbreaks and the possibility of wildlife carrying Giardia, there has been much interest in the waterborne transmission of giardiasis. Initial sampling, using E.P.A. Giardia sample collection units at one site in Connecticut, in August 1977 was positive for Giardia cysts. Another water supply revealed a possible positive for Giardia cysts from a water sample. Based on the possibility that Giardia could be of health significance in Connecticut water supplies and carried by watershed animals, this study was undertaken.

SECTION 2

CONCLUSIONS AND RECOMMENDATIONS

This study has demonstrated that Giardia contamination in Connecticut water supplies and water shed animals is not a problem in those areas sampled by the methodology employed. If Giardia contamination of the areas sampled can be said to be representative of Connecticut then Giardia contamination in Connecticut water supplies during the period studied may have been insignificant. This conclusion is based on the results from the two measurements to determine the presence of Giardia. The first method determined the presence of Giardia in the water supplies using the EPA Giardia sample collection units. No Giardia was found using this method. The second method was the collection of animal fecal specimens to determine the presence of Giardia in wildlife populations found on public water supply watersheds. Giardia were found in only a small percentage (1.45%) of those animal samples tested. Deer could be eliminated from future studies of Giardia based on the negative results of 145 samples examined. Animal fecal samples that were collected from trapped animals showed a slightly higher prevalence of Giardia than did samples collected from live animal droppings. Therefore, collection of animal fecal samples for Giardia determination should be made from trapped animals. Before further testing for Giardia is undertaken in Connecticut water supplies, the methodology for determining the presence of Giardia in water should be improved, so that Giardia can be reliably detected in small quantities.

SECTION 3

EXPERIMENTAL PROCEDURES

STUDY DESIGN

Two methods were used to determine the occurrence of Giardia in this study.

One method used to collect water samples was the EPA large volume samplers at selected water utilities with subsequent analysis for Giardia cysts. These samples were collected monthly at each site. The sampling device was on-line for an approximate 24 hour period. Additional samples were collected with this sample for the following analyses: total coliform, fecal coliform, standard plate count, yeast, turbidity, chlorine residual and pH. If Giardia was discovered on the sampling filter, correlations between the presence of Giardia and the other water quality parameters could be attempted. Yeast samples were collected for only the last 7 months of the 12 month sampling period because of delays initiating this part of the study.

The other method to determine the occurrence of Giardia involved the collection of fecal specimens from beaver, deer, squirrel, muskrat and raccoon if these were present on the watershed. The fecal specimens were placed in vials containing 10.0% formalin to be analyzed later for Giardia. Fecal samples were collected by two methods. During trapping season, and if permission was granted by the utility, animals were trapped by use of the leg-hold trap. The fecal sample was removed from the intestine of the dead animal. After trapping season all fecal samples were collected from the droppings of live animals. Initially the fecal samples were to be collected by only one method, live trapping of the animals. This method was found to be more expensive than using the "leg-hold" trap because the trapper would have to purchase "catch-em-live" type traps. This type of trap required much more room when transporting between trapping locations. A method of marking the animals would be necessary when using the live-trapping method to prevent sampling from the same animal more than once.

GIARDIA METHODOLOGY

Water

A. Sample received as wound orlon filter (7 μ porosity) with either a stainless steel or plastic core.

B. Filter removed from support core.

C. Blended in Waring blender with 1000 ml of sterile distilled water.

D. If sediment was less than 5% of total volume after blending, water was passed through at 30 μ and 10 μ porosity nylon screens and a 5 μ polycarbonate filter (initially the final screen was an 8 μ polycarbonate filter). Material was washed from final filter with 1 to 2 ml of distilled water and examined micrcscopically.

E. If sediment was greater than 5% of total volume after blending, the following flocculation procedure was performed. The water was acidified with 2 ml concentrated HCl. It was then stirred with a magnetic stirrer for 15 min and allowed to settle for 10 min. After settling, the water was filtered through three layers of surgical sponge. After the filtration proceed as in Step D above.

Animal Feces

A. Formalinized fecal samples were received.

B. These were concentrated using the formalin ether concentration technique (10).

C. Direct wet mounts of the concentrated material, unstained and iodine-stained, were examined microscopically.

YEAST METHODOLOGY

Enumeration Study

A. Melt and store yeast extract malt extract agar (YMA) in water bath at 45-50°C.

B. Adjust pH of YMA to 3.7 with 1 N HCl.

C. Pour 5 ml of YMA into petri dish, allow to solidify.

D. Prepare 1:10 and 1:100 dilutions of water sample.

E. Perform filtrations as directed in "Standard Total Coliform Membrane Filter Procedure" Standard Methods (12).

F. After filtration place membrane filters in an upright position on top of the agar in the previously prepared YMA plates. Incubate at 22-25°C for 72 hours.

G. Examine growth for white or pigmented colonies from the top of the culture dish, using a dissecting microscope. Count and record yeast colonies in the plate.

Identification

A. From colonial growth on YMA streak out for purity:

1. Sabouraud's dextrose agar plate.

2. Mycosel agar plate incubate at room temperature (22-25°C).

B. From single, isolated colony prepare:

1. Wet mount (using sterile water) for microscopic examination to determine size, shape, type of budding and presence of ascospores.

a. If wet mount reveals ascospores then yeast is of the genus Saccharomyces, Hansenula, Pichia or Endomycopsis.

b. If wet mount reveals cells with no ascospores, serum is inoculated and a cornmeal agar cut is done for mycelia and/or blastospore and chlamydospore production.

c. If wet mount reveals absence of mycelia, an India ink preparation is set up to determine if capsules are present.

d. When presence or absence of mycelia, pseudomycelia, chlamydospores, blastospores, or arthrospores is determined which identifies genus, speciation is made by assimilation tests using a parallel system of API 20C strips and Wicherham's tube method which employs the following carbohydrate solutions: dextrose, maltose, sucrose, lactose, galatose, mellibiose, celliboise, inositol, xylose, raffinose, trehalose, and dulcitol.

BACTERIOLOGICAL METHODOLOGY

Three different bacteriological analyses were performed on water samples collected prior to and after the Giardia sampling filter was on-line. The three tests were: total coliform, fecal coliform, and standard plate count. All the procedures for these tests were from Standard Methods for the Examination of Water and Wastewater (12).

WATER SAMPLE COLLECTION PROTOCOL

Giardia

Water samples for analysis of Giardia were collected by EPA sampling method described in the proceedings of the AWWA Water Quality Technology Conference convened in December 1977 in Kansas City, Missouri. An orlon wound filter was used with this method. This filter concentrates Giardia cysts from large volumes of water.

The filter collects water for a 24 hour period. The flow of water is restricted by flow control valve to 1.89 liters per minute (.5 gpm). Between 470 to 1700 liters of water were filtered through the sampling device. The rates varied depending on turbidity and available water pressure at the sampling tap. The filters were transported to the laboratory in a cooler on ice on the day the units were collected. The filter tubes were removed aseptically from the housing after reaching the laboratory.

Bacteria

Bacterial samples were collected immediately prior to installing the orlon wound filters and immediately after the filter was removed. The bacterial samples were collected and transported to the State Laboratory for examination following procedures in the Standard Methods for the Examination of Water and Wastewater (12). The bacterial samples were tested for total coliform, fecal coliform and standard plate count.

Yeast

One liter grab samples of raw and treated water were collected for yeast after the water filter was removed. Samples were collected in accordance with Section 906A of Standard Methods for the Examination of Water and Wastewater (12). Samples were delivered on ice in a cooler to the State Laboratory for examination on the same day of collection.

pH

The pH of the water sampled was determined from the bacterial samples collected before and after the installation of the Giardia sampling filter. The pH was determined at the State Laboratory according to Standard Methods for Examination of Water and Wastewater (12).

Temperature

The temperature of the water was measured in the field before and after the Giardia filtering unit was placed on-line.

Turbidity

Samples were collected for turbidity in the containers used for bacterial sampling. Turbidity samples were collected before and after the Giardia sampling filter was installed. Turbidity was tested at the State Health Department Laboratory according to 214A, in Standard Methods for Examination of Water and Waste Water (12).

Chlorine Residual

Free and total chlorine was determined in the field using Hach Chlorine Test Kit Model CN66 and Lamotte DPD chlorine #1 and #3 tablets. Chlorine

was determined immediately before the Giardia filtering unit was placed on-line and immediately after the Giardia filtering unit was removed.

WATERSHED ANIMAL FECAL SAMPLE COLLECTION PROTOCOL

Animal fecal specimens were collected from leg-hold trapped watershed animals during the trapping season under the regulations and guidelines established by the State Department of Environmental Protection. Fecal specimens were collected from identifiable fecal droppings after the trapping season. Because trapping was not permitted at the Metropolitan District Commission reservoirs #5 and #6, watershed specimens throughout the test period were collected from identifiable droppings of live animals.

Trappers were selected from members of the Connecticut Trapper's Association who lived near the selected watersheds. These trappers were contracted to do the sample collection. The trappers were allowed to keep the pelts of the animals caught during trapping season. The trappers were given verbal and written instructions on how to collect the samples by the project coordinator (Appendix D). When the trappers were collecting the fecal droppings from live animals the trappers were requested to collect samples from different locations and take only one sample per animal. Hopefully this would reduce the possibility of sampling the same animal more than once. The fecal samples collected from the live animals had to be fresh and identifiable as to the type of animal from which it had come. Fecal specimens were collected for the 12 month study period. Sample containers and sterile applicator sticks were provided by the State Laboratory. The containers held a 10% formalin solution. A brief questionnaire (Appendix E) was provided with each sample vial. The trappers were required to fill out this form for every sample submitted. The information required was: type of animal, watershed, location on watershed and date collected.

Comparisons and correlations were made between the collection methods for obtaining the animal fecal specimens, site locations, and the physical and bacteriological test data with the presence of Giardia if any positive Giardia samples were found.

Laboratory Methods

The EPA large volume sampling filters were analyzed according to the EPA Methodology (7). The animal fecal samples were processed using the formalin ether concentration technique (10) and examined microscopically. The yeast analysis consisted of the enumeration and isolation procedures outlined in Standard Methods for the Examination of Water and Waste Water (12). The temperatures and chlorine residuals were determined at each site. The total and free chlorine residuals were determined by the DPD colorimetric method. The other water quality determinations were performed by the Laboratory Division of the Connecticut State Department of Health Services.

SECTION 4

DESCRIPTION OF WATERSHEDS AND SITES

A total of eight sites were selected to be samples for Giardia using the EPA Giardia sampling units. The watersheds surrounding these sites were sampled for animal fecal specimens by trappers with permission from the utility or land owner.

SITE SELECTION

The sites that were sampled were selected in two ways: (1) areas with low and high stool positivity rates for Giardia; and (2) watersheds with no known human activity (protected) and with human activity and/or human sources of sewage contamination (semi-protected). Giardia positive stool sample data provided by the State Department of Health Services were used to calculate human stool positivity rates for each town in Connecticut. Rates varied from .03 per 1,000 to 1.94 per 1,000. Two towns with low Giardia positivity rates were selected and matched with two towns with high Giardia positivity rates based on population density and population served by a community water supply. The project director selected additional sites based on Criterion #2. One source, a well owned by Bridgeport Hydraulic Company, which had been selected was changed because this source had not been used as a water supply for several years. The new site selected was Hemlock Reservoir which is an unfiltered surface water supply operated by the Bridgeport Hydraulic Company.

SITES

Metropolitan District Commission Reservoirs #2, #3, #5

This site (Figure 1) is located on Farmington Avenue in West Hartford. The sample locations are within the water treatment facility. Raw and treated water taps were sampled.

Treatment--

The treatment at the plant consists of coagulation, flocculation, sedimentation, slow sand filtration, chlorination, fluoridation, corrosion control, taste and odor removal.

Watershed--

The watershed area is four square miles (reservoirs #2,#3,#5 and #6). Reservior #5 serves as the terminal source. Nepaug and Barkhamsted

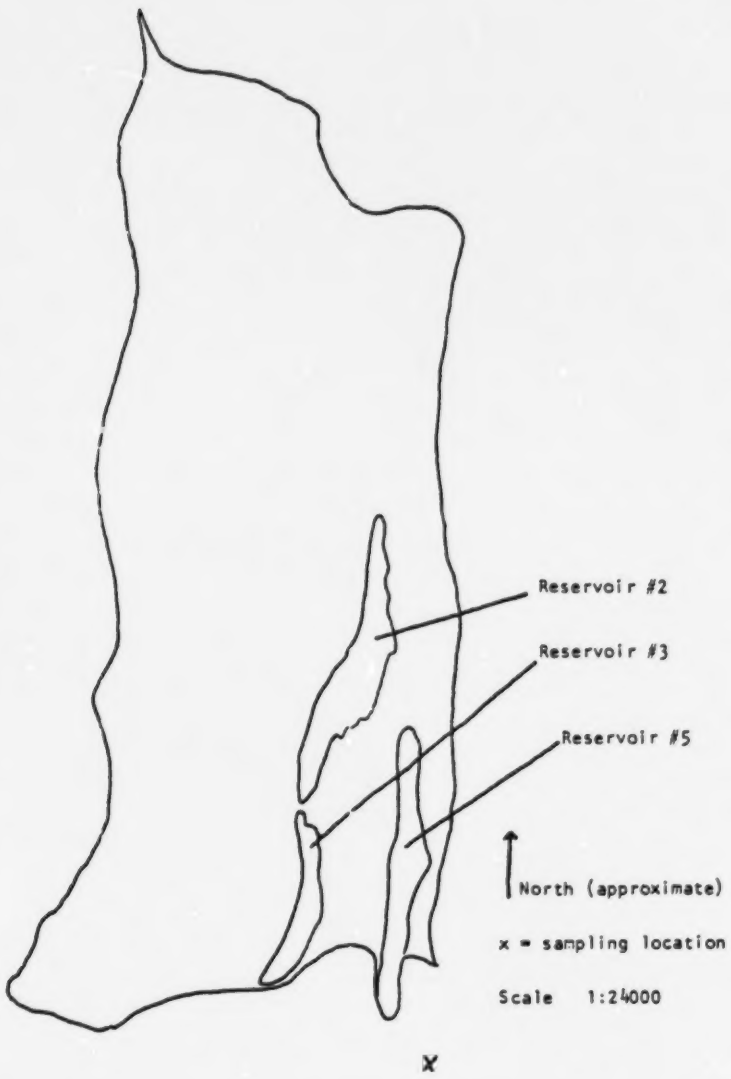

Figure 1. Diagram of the watershed for reservoirs 2, 3, and 5 and location of the metropolitan District Water Treatment Plant sampling site (X).

Reserviors are the sources of raw water. Reserviors #1, #3, #5 and #6 are interconnected. Animals present on watershed #2, #3 and #5 that were sampled for Giardia included: muskrat, squirrel, raccoon and deer. There were no beaver colonies located on reserviors #2, #3 and #5.

Watershed Protection--

The area around the reserviors is used for limited recreation which includes: jogging, bicycling, hiking, picnicking. No fishing, hunting or overnight camping is permitted. Patrols are regularly maintained. Annual watershed inspection is performed by the utility.

Historical Water Quality--

The water quality has consistently met all water quality standards of the Public Health Code of the State of Connecticut.

Barkhamsted Watershed--

No industries are present on the watershed (Figure 2) but a considerable number of miles of highway are located on the watershed. There are a few farms located on the watershed but these are at a considerable distance from the reservior. The watershed area is 53.8 square miles most of which is covered by deciduous hardwood forest.

Protection of Watershed--

Portions of the Barkhamstead at the dam and the north end of the reservior are fenced off. The Metropolitan District Commission (MDC) regularly patrols the watershed.

Metropolitan District Commission Reservior #6

This site (Figure 3) is located off Route 44 on the West Hartford and Bloomfield town lines. The raw and treated water taps within the treatment facility were sampled.

Treatment--

The treatment of the water is coagulation, flocculation, sedimentation, rapid sand filtration, chlorination, fluoridation, corrosion control, taste and odor control.

Watershed--

The watershed area for reserviors #2, #3, #5 and #6 is equal to 4 square miles. There are only 3 dwellings on reservior #6 watershed. Each of these has its own septic tank system located a considerable distance from the reservior. Muskrat, raccoon, deer, squirrel and a few beaver are located on the watershed. The watershed is covered mainly by hardwood forest, with red pine immediately surrounding the reservior.

Watershed Protection--

The area surrounding the reservior is open for restricted recreation during the day time. Jogging, bicycling and picknicking are permitted on the watershed. No fishing, hunting or overnight camping is allowed. An annual watershed survey for pollution sources is conducted by the water company. The watershed is regularly patrolled by the utility.

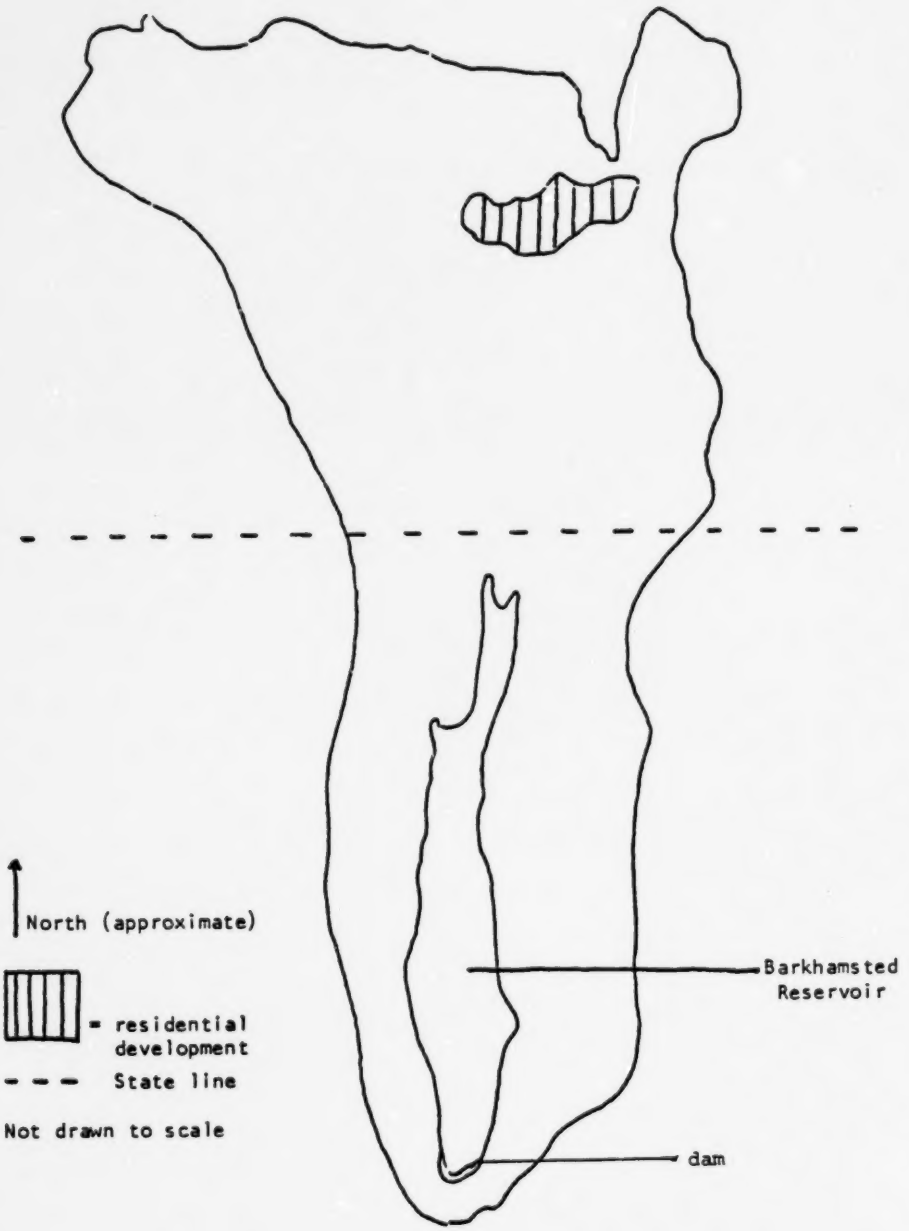

Figure 2. Diagram of the watershed for the Berkhamsted reservoir used by the Metropolitan District Commission.

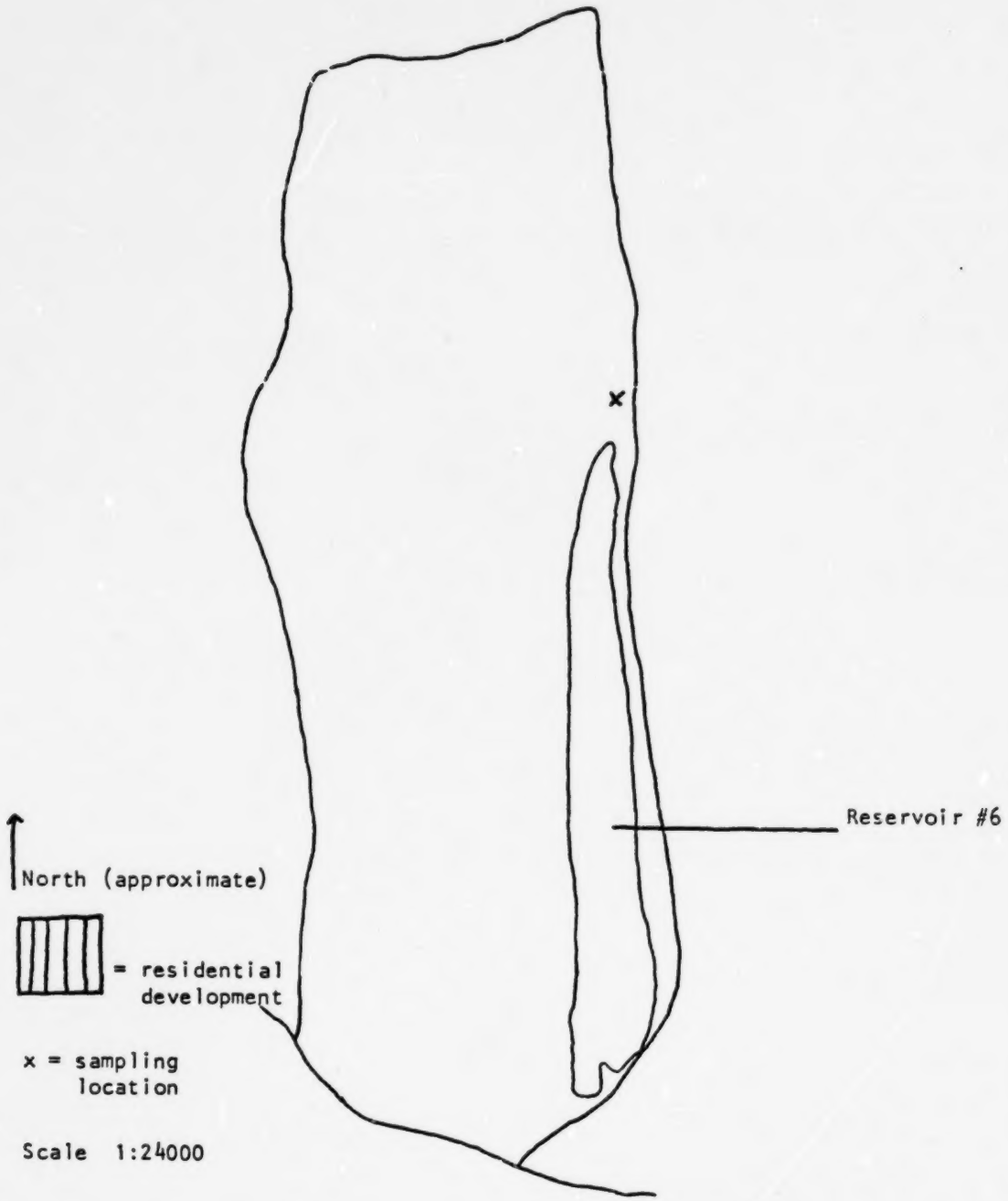

Figure 3. Diagram of the watershed for Reservoir #6 and location of the Metropolitan District Commission Sampling Site (X).

Water Quality--

The water quality consistently meets all the water quality standards in the Public Health Code of the State of Connecticut.

New Britain Water Department Shuttle Meadow, Wesel and Whigville Reservoirs

These reservoirs (Figure 4) are located in the towns of Berlin, Bristol and New Britain. The sample location was at the treatment plant at 1000 Shuttle Meadow Avenue, New Britain, CT, where the three sources are combined. The raw and treated water taps were sampled for Giardia.

Treatment--

The treatment at the plant is filtration, chlorination, fluoridation, corrosion control, taste and odor control.

Watershed--

The watershed area of Shuttle Meadow Reservior is 2.94 square miles. Wasel Reservoir watershed area is .37 square miles. The Whigville Reservoir watershed is 3.99 square miles. There are 200 residences on the Whigville watershed, 10 residences on Shuttle Meadow Reservoir watershed and no residences on Wasel Reservior watershed.

Watershed Protection--

An annual watershed survey is conducted by the water department on these watersheds for pollution sourcese. Signs are posted by the water department with some fencing protecting the reservoir.

Water Quality--

The water quality has met the standards of the Public Health Code of the State of Connecticut, once the Whigville Reservoir supply had been piped to the filtration plant for treatment.

Collinsville Water Company, Napaug Reservoir

The sampling location (Figure 5) was at the treatment facility in Collinsville.

Treatment--

The treatment at this plant is strainers, chlorination and corrosion control.

Watershed--

The watershed area is 31.85 square miles. The Napaug Reservior can also serve as the supply for the Metropolitan District Commission. There is a residential development on the Nepaug Reservoir watershed but no industry. One gas station is on the watershed. There are over 1000 dewllings, two orchards, and 4 or 5 farms on the watershed. None of the farms are close to the edge of the reservoir. Deciduous hardwood forest covers much of the watershed that is not residentially developed.

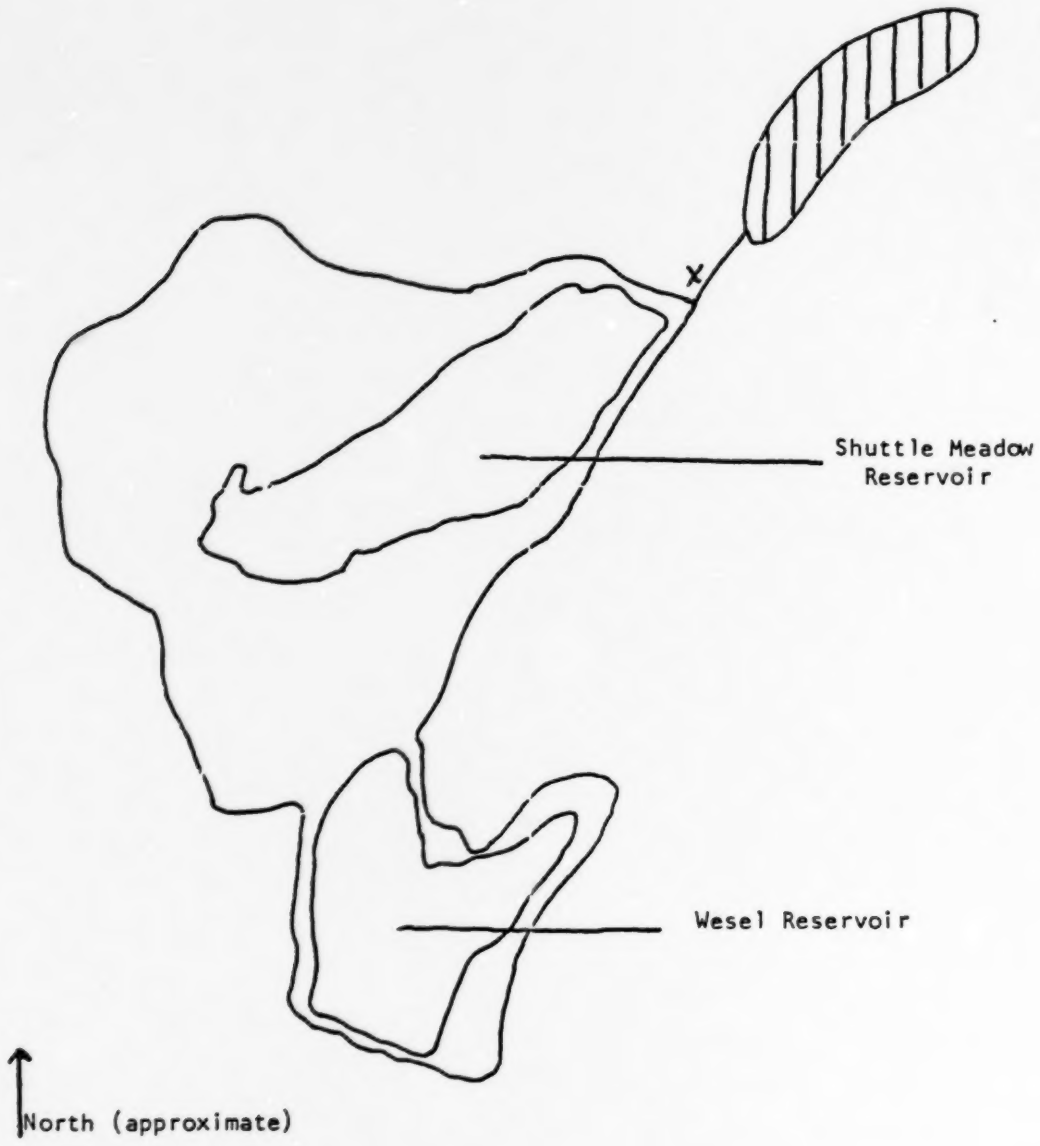

Figure 4. Diagram of the watershed for the Shuttle Meadow and Wesel reservoirs and location of the New Britain Water Department treatment plant sampling site (X).

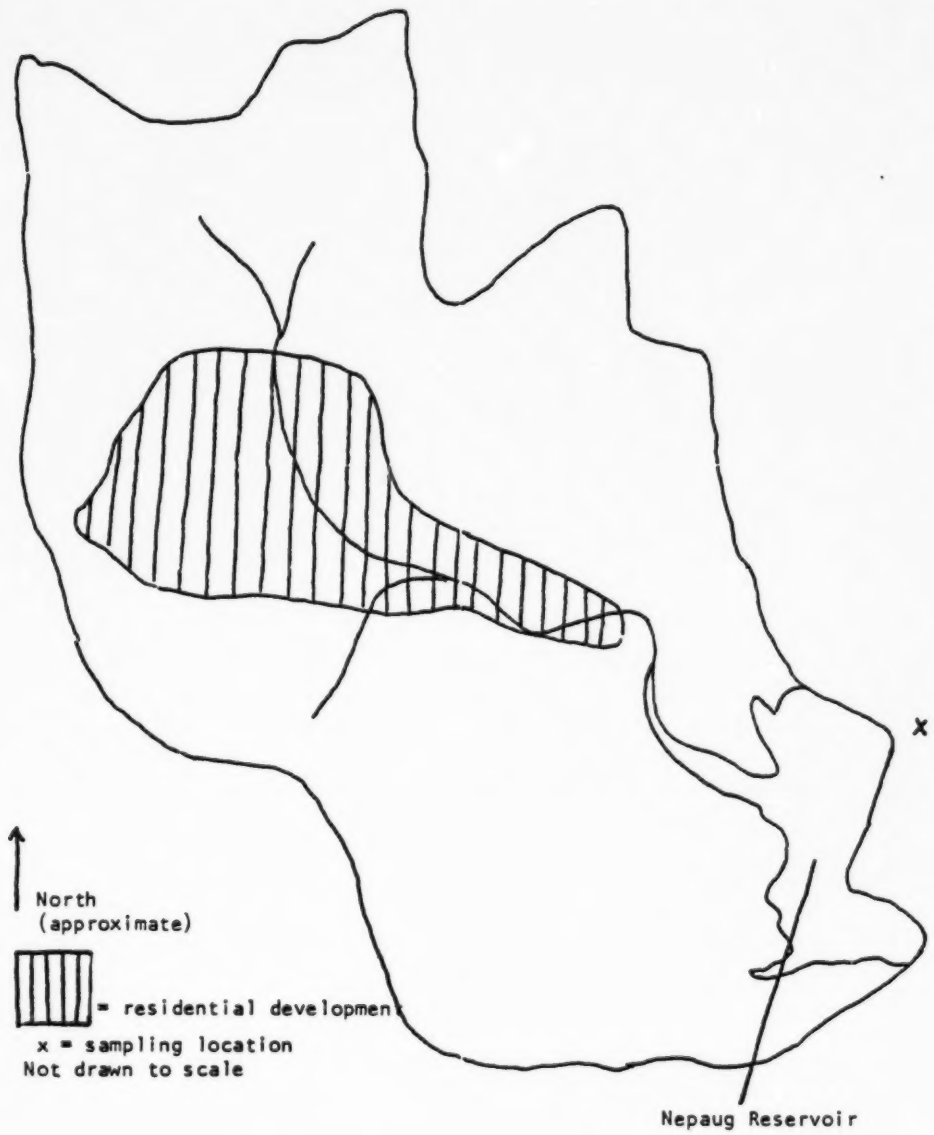

Figure 5. Diagram of the watershed for the Nepaug reservoir and location of the Metropolitan District Commission sampling site (X).

Watershed Protection--

The utility regularly patrols the watershed. Fencing is present around much of the reservoir. Signs denoting public water supply watershed are posted on the watershed. Annual watershed surveys are performed by the utility.

Water Quality --

The Collinsville water supply has water quality exemptions from the standards in the Public Health Code for color, odor and turbidity.

Greenwich Division (Connecticut American Water, Mianus River)

The location of the supply is in the towns of Stamford and Greenwich. The sampling location (Figures 6 and 7) is the Mianus River filtration plant on Valley Road in Greenwich.

Treatment--

The type of water treatment is filtration, chlorination, fluoridation, corrosion control, and taste and odor control.

Watershed--

The watershed area is 18.1 square miles. The Mianus Reservoir is located approximately 6 miles upstream from the filter plant. Hardwood deciduous trees surround the reservoir watershed although the portion near the dam is grass. No beaver colonies were discovered on the watershed. Deer, raccoon squirrel and muskrat inhabit the watershed. Most of the land between the reservoir and the filtration plant is privately owned residential development.

Water Protection--

Fishing with a permit is allowed upstream from the filtration plant. An annual watershed survery for pollution sources is conductd by the water company. Patrolling is done by the utility around the reservoir. Some fencing is present on the watershed.

Water Quality--

The water quality has met the standards for water quality as described in the Public Health Code of the State of Connecticut.

Stamford Water Company, North Stamford Reservoir

The sample location (Figure 8) is the North Stamford Reservoir treatment plant on Interlaken Road in Stamford.

Treatment--

The treatment of the water is with copper sulfate, microstrainer corrosion control, chlorination and fluoridation.

Watershed--

The watershed area is approximately 4.64 square miles. There are no beaver colonies on the North Stamford Reservoir. Deer, raccoon, squirrel

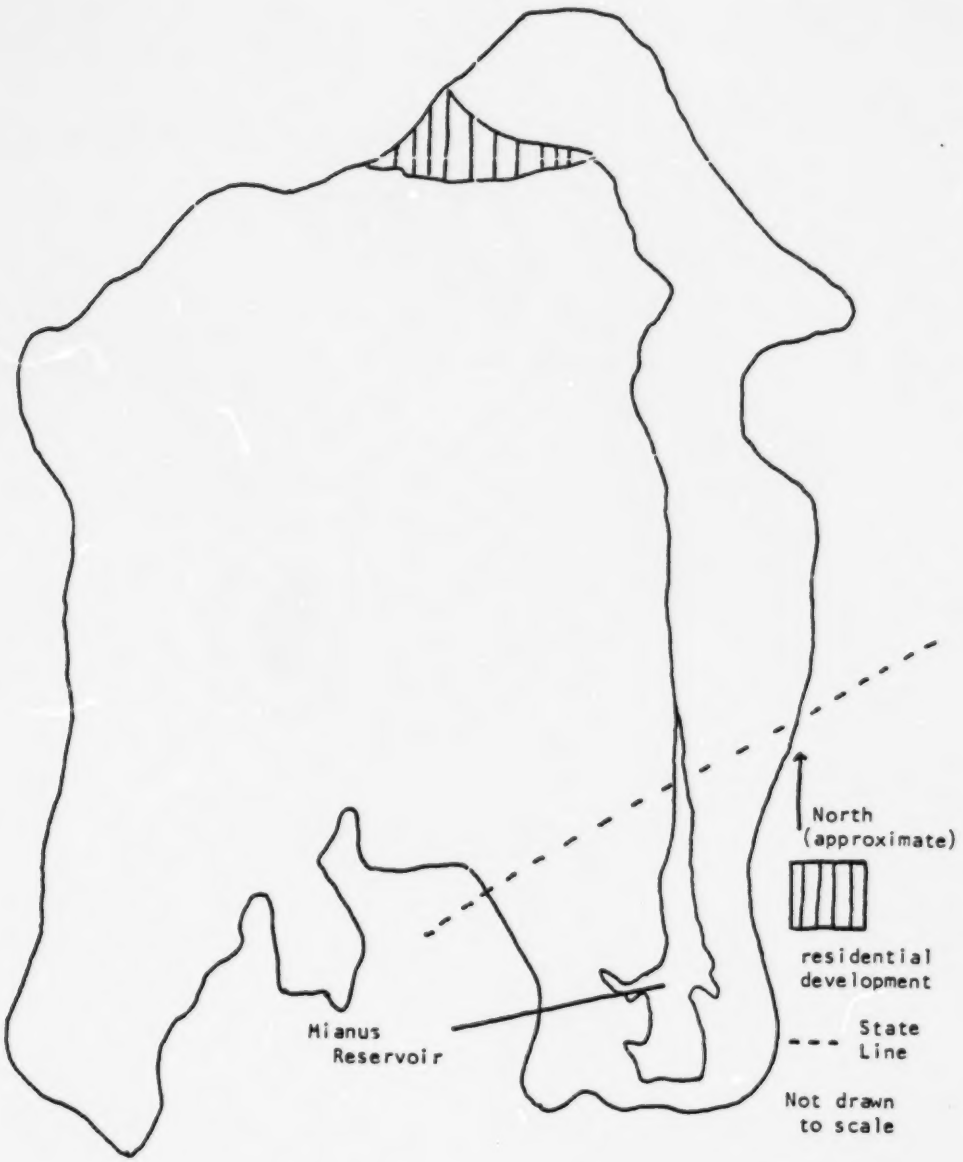

Figure 6. Diagram of the watershed for the Mianus Reservoir used by the Connecticut American Water Company.

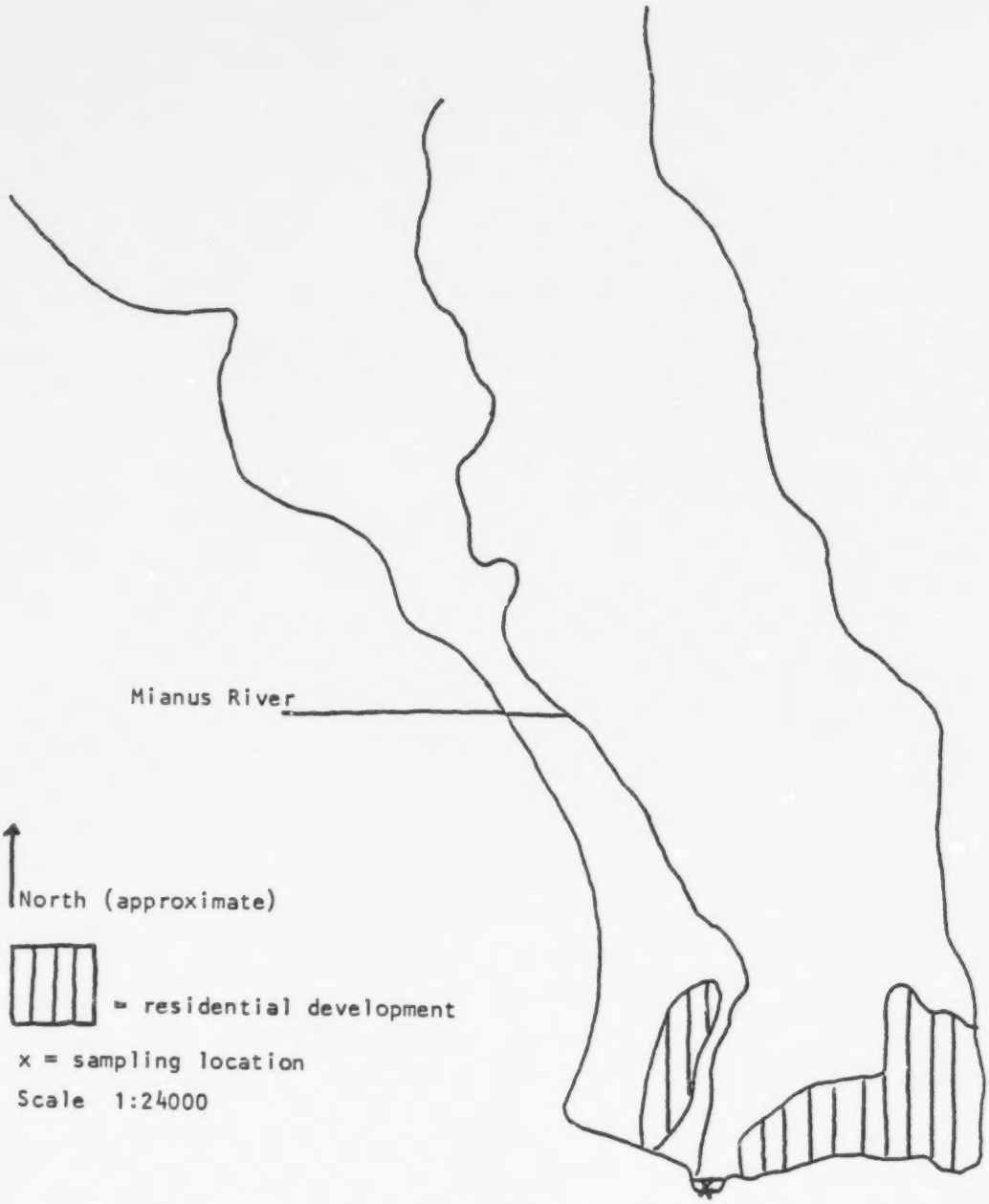

Figure 7. Diagram of the watershed for Mianus River and location of the Connecticut American Water Company water treatment plant sampling site (X).

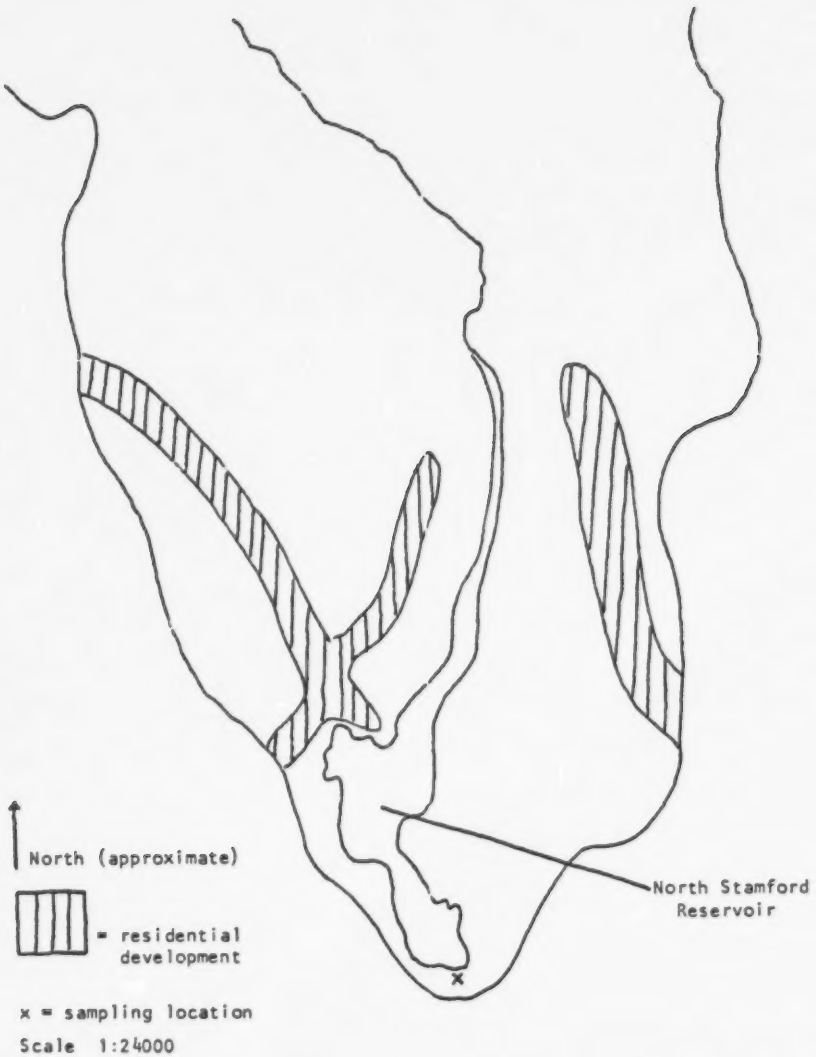

Figure 8. Diagram of the watershed for the North Stamford reservoir and location of the Stamford Water Company water treatment plant sampling site (X).

and muskrat inhabit the watershed. An employee of the Stamford Water Company collected samples from the watershed animals. Coniferous trees surround the reservoir edge and hardwoods predominate on the watershed. Residential development is present on the watershed.

Watershed Protection--

Recreation is not permitted on the watershed. A restricted amount of logging supervised by the water company is allowed on the watershed. Fencing surrounds the reservoir and the water company patrols the area. An annual watershed survey is performed by the water company.

Water Quality--

Exemptions from violation of the Public Health Code Standards have been granted to Stamford Water Company for color and turbidity.

Newtown Water Company, Taunton Pond

Taunton Pond (Figure 9) is located in the town of Newtown. The sample location is in the town hall on Main Street in Newtown.

Treatment--

The type of water treatment for this system is chlorination and corrosion control.

Watershed--

The watershed area is 1.25 square miles. Taunton Pond has many older residential houses which have individual septic tank systems. Many of these houses are close to the water's edge. The water company owns less than 2 acres of the land on the watershed, where the intake pump and treatment equipment are located. Pets of the residential owners were frequently observed on the watershed.

Watershed Protection--

Taunton Pond is used for some recreational activities. A fish and game club is permitted to fish on the reservoir. The reservoir is not fenced off but posting is present. There is no full time employee to run the pumphouse or patrol the watershed. An annual watershed survey for pollution sources is performed by the water company.

Water Qaulity--

This water supply has been granted exemptions from the water quality standards of the Public Health Code for turbidity and color.

Bridgeport Hydraulic Company, Hemlock Reservoir

The location of sampling was the reservoir treatment plant on Route 58 in Fairfield and Easton. The Aspetuck (Figure 10) and Saugatuck (Figure 11) are storage reservoirs for the Hemlock Reservoir (Figure 10).

Treatment--

The treatment at Hemlock Treatment Plant is chlorination, corrosion control, and fluoridation.

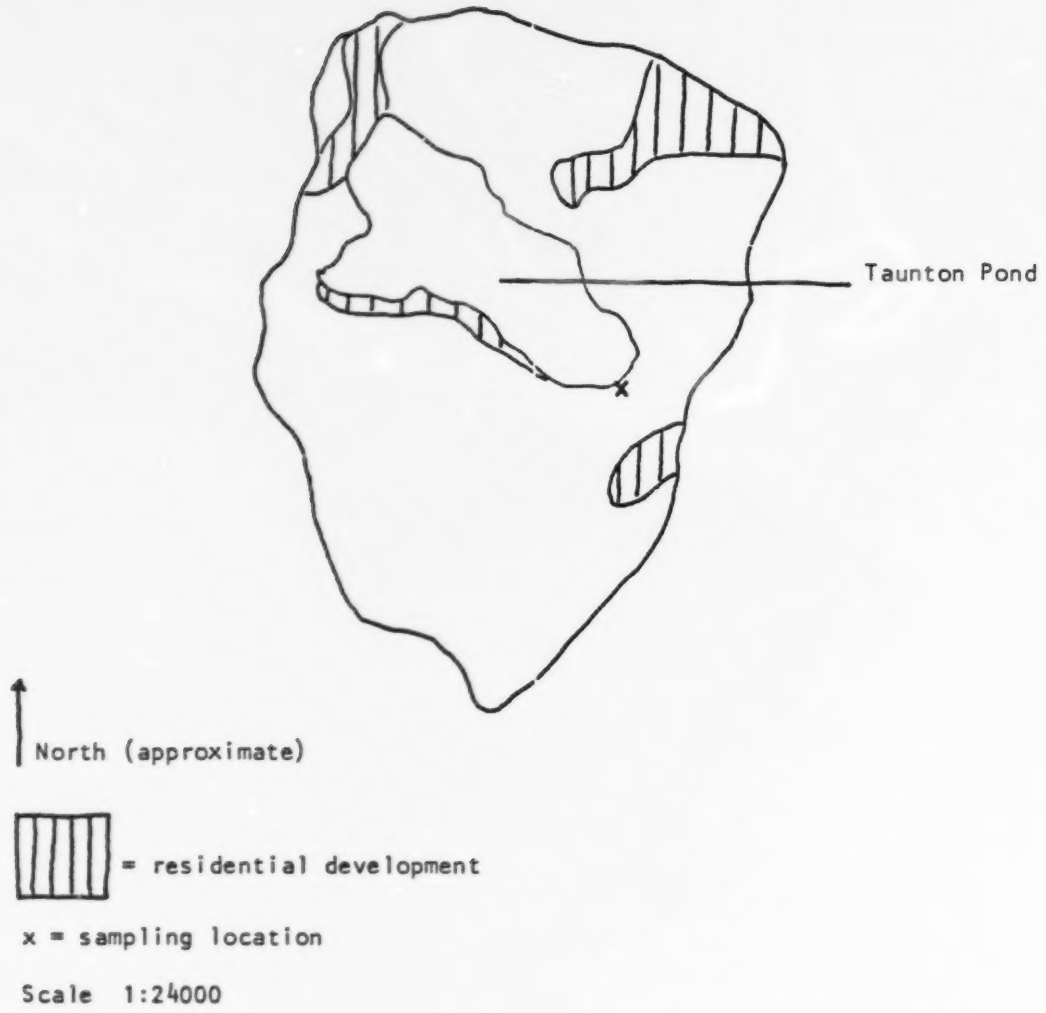

Figure 9. Diagram of the watershed for Taunton Pond and location of the Newtown Water Company water treatment plant sampling site (X).

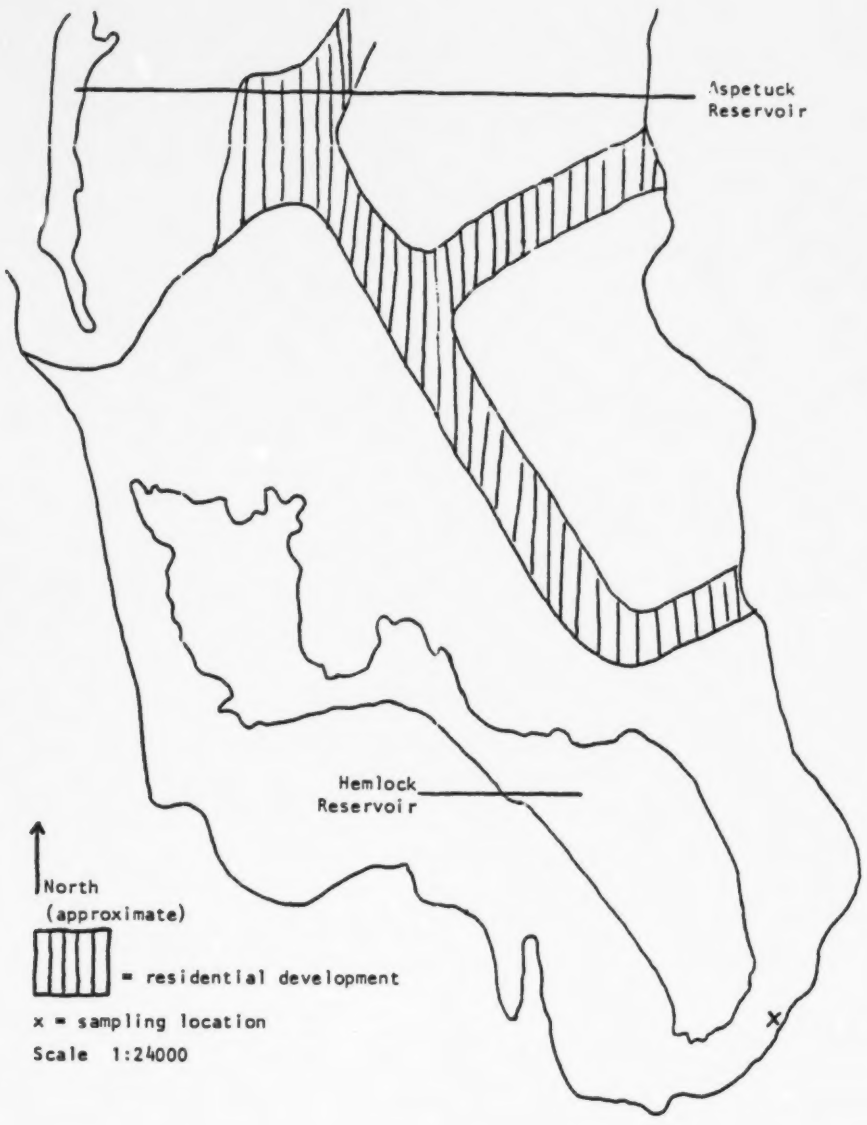

Figure 10. Diagram of the watershed for Hemlock reservoir and location of the Bridgeport Hydraulic Company water treatment plant sampling site (X).

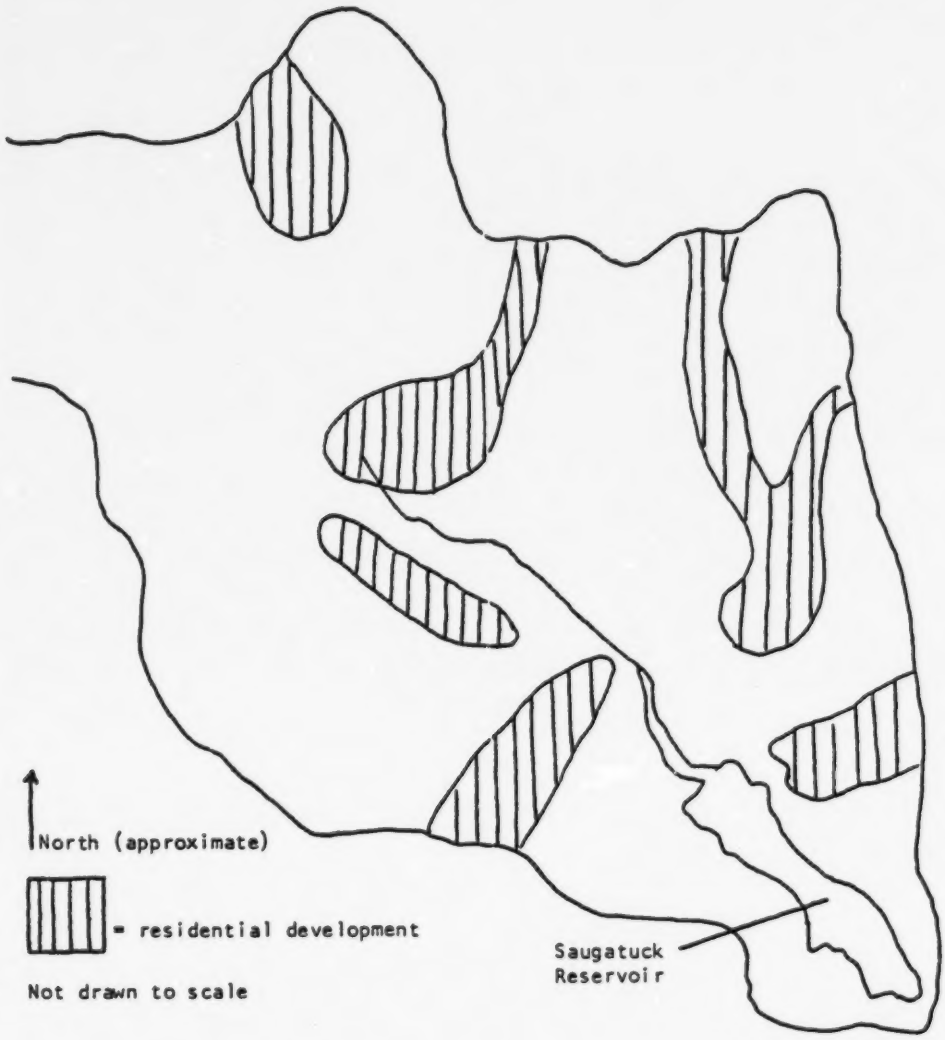

Figure 11. Diagram of the watershed for the Saugatuck reservoir used by the Bridgeport Hydraulic Company.

Watershed--

The watershed area for the Hemlock Reservoir is 5.22 square miles. The Saugatuck watershed is 35.0 square miles and the Aspetuck is 17.0 square miles. There are residential developments on the watersheds. No beaver colonies were found on the watersheds. Deer, squirrel, raccoon and muskrat were present on the watershed. Deer were the most plentiful species on the watershed of those species sampled for Giardia.

Watershed Protection--

Signs are posted on the watersheds prohibiting trespassing, fishing, or hunting. Selected areas under the supervision of the water company are used for logging operations. One area is rented by a gun club for shooting practice. Some fencing is present on the watershed. The water company regularly patrols its watersheds.

Water Quality--

The water quality has met the water quality standards of the Public Health Code.

SECTION 5

RESULTS AND DISCUSSION

ANIMAL FECAL SAMPLES

A total of 413 animal fecal specimens were submitted for Giardia determination over the 12 month study period from November 1979 through October 1980. Samples included 93 muskrats, 146 deer, 107 raccoons, 19 squirrels, and 48 beavers. The samples were collected on 11 watersheds, all of which were part of the 8 selected study areas. All the beaver specimens came from one watershed area and therefore may not be a reliable index of Giardia in Connecticut's beaver population.

A total of 413 specimens were submitted for analysis and only 6 or 1.5% were found to be positive for Giardia. Only muskrats and raccoons were found to be positive for Giardia of those animals tested. The prevalence of Giardia in all muskrat samples tested was 4 of 93 samples or 4.3%. The prevalence of Giardia in all raccoon specimens was 2 of 107 samples or 1.9%.

Giardia was found in animal samples on 4 of the 11 watersheds which comprise the 8 study areas. Three of the 4 muskrat samples that were positive for Giardia came from the Saugatuck watershed. The other positive sample came from the Mianus River. The two raccoon Giardia positive samples were taken from different watersheds, the Shuttle Meadow Reservoir watershed and the Mianus River watershed (Table 1).

Samples that were submitted during trapping season, November 1979 through February 1980, showed a higher percent positivity for Giardia, 2.34%, than samples collected after trapping season, 1.1%, (Tables 2 and 3). There was no difference in percent positivity for Giardia in raccoon samples collected during trapping season as compared to after trapping season. Muskrat fecal sample results do show a difference. Those muskrat fecal samples collected during trapping season were 7.4% positive for Giardia. The muskrat fecal samples collected after trapping season were 3.1% positive for Giardia. During examination of the fecal specimens for Giardia-like cysts, other parasites were found in many of the samples. The beaver specimens, mainly from one watershed, had the lowest percentage (16.7%) parasites found of the animal types studied. The raccoon specimens were found to have the most parasites of the animals examined with 64.8% of the specimens positive for parasites. Most of the other parasites found were helminths. Many of the animals showed evidence of infection with nematodes. A large number of unidentifiable nematode larvae were observed along with eggs which resembled Toxocara sp., Trichuris sp. and hookworm. Cestode eggs resembling Diphyllobothrium were found mainly in muskrat samples in about

20% of the samples examimned. One or two parasites were observed in most of the animal specimens. Multiple parasite observations were much more common in raccoon specimens. Six parasites were found in one specimen.

Large Volume Sampling Method

A total of 144 water sampling filters were collected for analysis using the EPA large volume sampling method for collection of Giardia cysts. All filters were determined to be negative for the presence of Giardia.

Yeast Sample Results

A total of 74 samples were tested for yeast. Thirty of these samples were from raw water sources and 44 of the samples were from treated water sources. Yeasts were found in 12 of the 30 raw water samples. The following types of yeast were isolated: Candiada tropicalis, Geotrichum sp., Trichosporon capitatum, Saccharomyces, cerevisiae, Candida lambica, Hanseniaspora uvarum, Candida parapsilosis, Candida humicola. Yeasts were identified in only 3 samples of the 44 samples from the treated water samples. The three yeast identified in treated water samples were Candida humicola, Candida parapsilosis, and Candida zeylanoides.

Bacteriological Results

A total of 288 water samples were taken for bacteriological analysis during the study period. Two hundred and eighty four of these samples were tested for total coliform bacteria. Sixty six, 69.5% of the 95 raw samples that were tested revealed total coliforms. Three of the 190 treated water samples were positive for total coliform.

Two hundred seventy four samples were tested for fecal coliform bacteria. Fecal coliforms were found in 31 of 92 raw water samples. Only 3 treated water sample of 182 samples were found positive for fecal coliforms.

Two hundred fifty one samples were examined for total bacteria by the standard plate count method. Eighty one of 83 raw water samples were found to have bacteria. One hundred and twelve treated water samples of 168 samples tested were found to have bacteria. The most colonies found on a standard plate count for a raw water sample was 6000, on a sample taken in July 1980 at the Mianus River treatment plant. Forty-one of the 82 raw water samples had plate counts of less than 100 colonies.

The most colonies found on a standard plate count for a treated water sample was 920 colonies on a sample taken in September 1980 at the Collinsville Water Company treatment station. Eighty three of 168 treated water samples had colony counts of 1 or 0. Seventy eight of the remaining 85 had less than 100 colonies. Most of these samples contained less than 50 colonies.

DISCUSSION OF RESULTS

The data collected indicated that Giardia was not prevalent in the beaver, muskrat, deer, squirrel and raccoon samples on the selected watersheds. Giardia was not found in any of the beaver, deer and squirrel samples collected. The prevalence of Giardia in the muskrat and raccoon was low, 4.3% and 1.9% respectively. This perhaps underestimates the true prevalence of Giardia because the animals might shed cysts intermittently as is the case with man (4). About one half of the infections that exist will be detected if a fresh sample is examined correctly using an appropraite procedure by a microscopist capable of identifying the protozoa (4).

Animal samples collected from October 1979 through February 1980 show a slightly higher prevalence of Giardia than those samples collected from March 1980 to October 1980. Since October to February is trapping season, the muskrat, raccoon and beaver samples were collected mainly from trapped animals. This indicates that obtaining samples from trapped animals may be a better method to determine if an animal has Giardia. When samples were not obtained from trapped animals, identifiable droppings were collected by the trappers.

Fecal droppings from an aimal with Giardia might not be as easily identified by the trapper as the droppings of a healthy animal. Diarrheic samples, therefore, might be avoided. Another problem is that as feces become formed and dryer, distortion of the cysts can result (3).

The three Giardia positive results from the Saugatuck Reservoir watershed indicate that a small pocket of muskrats have been infected with Giardia. In the other watersheds where Giardia was found, Giardia did not seem to be prevalent in the wildlife population sampled.

The results using the large volume water filter for collecting Giardia cysts were negative for both raw and treated water sampled. This would seem to indicate that contamination from Giardia in the selected water supplies was not present. The limitations of this methodology show a recovery of cysts in one seeding experiment of a mean of about 6% (5). Therefore, it is possible that Giardia is present but at levels too low to be detected. Gross contamination with Giardia in the selected water supplies sampled is unlikely.

Because the beaver fecal specimens were collected mainly from the Barkhamstead watershed, the samples may not be representative of the beaver population throughout the state. This could affect the result of no parasites found in 83.3% of the beaver samples examined. It is possible that there are pockets of animals which are relatively free of parasites on the Barkhamstead watershed.

No correlation could be made in this study between the presence of Giardia and bacteria, chlorine residual, pH, temperature, yeast, and turbidity because Giardia was not found in the sampling filters.

Coliform bacteria and yeast were found frequently in raw water samples but rarely in treated water. During the study period the raw and treated water samples consistently met the bacteriological water quality standards of the Connecticut State Public Health Code. The presence of coliforms in raw water indicates the possible existence of fecal contamination. It is possible, therefore, that Giardia could be present.

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APPENDIX A

Permission is granted to_____ _____ to trap on_____ on water company land or privately owned land by_____ for the period_____ to_____1979-1980 and to collect fecal samples from_____to_____for Henry Adams, Water Supplies Section, Department of Health Services, State of Connecticut.

It is the understanding that the trapper comply with all the laws pertaining to the conservation of fish and game and restrictions by permittee and comply with provisions of contract.

Date _____ Signature _____ (Trapper)

Date _____ Signature _____ (Water Co. Official)

Date _____ Signature _____ (Project Coordinator)

APPENDIX B

Giardia Survey Data

Date _____ Sample No. _____

Sample Collection Point _____

_____

				Chlorine	
Master Reading	Time	pH	Temp.	Free	Total
Start					
Stop					

Turbidity

Bacteriological Analysis

Coliform/100 ml.

Fetal Coliform/100 ml.

Standard Plate Count/ml.

Remarks:

APPENDIX C

PROTOCOL FOR USING THE LARGE VOLUME SAMPLER FOR CONCENTRATING GIARDIA FROM WATER

I. Bacteriological Sample

Collect a "grab" sample for bacteriological analysis in accordance with Standard Methods for the Examination of Water and Wastewater (14th Ed.) before and after sampling for Giardia.

Refrigerate (Do Not Freeze) samples or pack in wet ice for transport to the laboratory for bacteriological examination.

II. Giardia Sample

Assemble large volume sampler for Giardia concentration (Fig. 1).

A. Connect female ( ) hose fitting on sampler to male ( ) hose bib fitting on sampling tap.

B. Connect female quick disconnect (q.d.) fitting to the male q.d. on the filter unit. (The lid of the filter unit should be tightened using the filter housing wrench. Water flow through the filter tube should be from outside the filter tube to inside the filter tube). The arrow on the top of the unit housing should be pointing away from the stream of the influent hose bib. (Be sure the flow of water is from the outside to the inside of of the filter tube).

C. Connect the male ( ) q.d. of the short piece of hose to the female ( ) q.d. of the filter housing.

D. Connect the water meter to the hose fitting. (Be sure there is a washer in the hose fitting. Sometimes two washers may be necessary to prevent leaking). Be certain that the flow of water through the water meter is in the right direction. (Correct flow is in the direction of the arrows beside the meter readout).

E. Connect the 0.5 gpm flow control valve to the water meter.

F. A hose may be connected to the flow control valve to direct the effluent water to waste.

G. Check all connections for tightness and leak prevention. (Extra washers and teflon tape should be available).

H. Read and record the meter reading and time you start sampling on the bench sheets (Fig. 2). Also read and record the temperature (°C), pH, chlorine (free and combined) and turbidity (T.U.)*.

I. The 0.5 gpm flow control valve will allow approximately 500 gallons to be filtered at 15-18 psi in 18 hours. Five hundred (500) gallons is the suggested sample size. When 500 gallons cannot be sampled, the amount most practical should be sampled as determined by common sense.

J. At the end of the sampling period the meter reading and time are recorded.

K. The filter housing may be removed at this time by disconnecting it at the q.d.'s. The filter holder is inverted and residual water is drained from the effluent end of the holder. Using the filter housing wrench the cap may be removed. The filter tube is removed aseptically using sterile rubber gloves. The filter is placed into a plastic bag and sealed with a wire tie or tape. This plastic bag is labeled distincly with <u>waterproof</u> ink. The bag containing the filter should be kept under refrigeration, <u>NOT FROZEN</u>, until it can be processed.

L. The "after" bacteriological sample, temperture, pH, chlorine (free and combined), and turbidity are taken at this time.

M. If the site is to be resampled immediately, the filter housing should be reassembled <u>without</u> a filter tube. The water to be sampled should be allowed to run through the sampling apparatus for 5-10 minutes.

N. The filter housing cap then should be removed and a filter tube placed into the filter housing aseptically. The meter reading, time and physical data should be recorded. The "after" sample (L) in this instance will become the "before" sample (M) for resampling at the same site.

O. When new sampling sites are to be examined with a pre-used filter housing unit, the filter unit, <u>without</u> a filter tube, should be connected to the influent water tap, after the bacteriological sample and the physical data have been obtained. The "new" water should be allowed to flow through the unit for 5-10 minutes. The filter tube should then be inserted into the housing aseptically and sampling started.

*Turbidity may be determined from surplus water collected from the bacteriological samples.

III. Suggested Supplies and Tools

A. Pipe wrench (2)

B. Crescent wrench (2)

C. Screw driver (2, small and medium)

D. Hose washers

E. Garden Hose (as needed)

F. Teflon tape

G. Pump (as needed)

H. Electrical extension cord (as needed)

I. Waterproof ink pen (2)

J. Tape or wire ties

K. Water sampling bottles for bacteriological sampling with dechlorinating agent added

L. Portable pH meter

M. Thermometer (2)

N. DPD chlorine test kit

O. Ice chest

IV. It is strongly suggested that all sites be inspected before sampling to determine necessary equipment and plumbing connections, and also if source and finished water can be collected. Characteristics such as pumps operating on water demand may determine the amount of water which can be sampled and the time sampled. The sanitary survey forms (Fig. 3) can also be filled out at this time to give a better understanding of the system to be sampled.

APPENDIX D

Directions for Obtaining Fecal Sample From Trapped Animals (in Season)

1) While skinning the animal (muskrat, beaver, etc.), obtain fresh (as soon as possible) stool specimen from the lower intestine (near anus). Be sure to completely clean knife between animals.

2) With applicator sticks provided, add portion of feces about the size of a walnut to solution. Make sure solution covers feces completely. Mix and cap tightly. Do not add anything else to container.

3) Discard stick; do not use again.

4) Leave specimen bottle at treatment plant or pre-arranged point with data form completely filled out. This should be done as soon as possible.

Directions for Obtaining Fecal Sample (Out of Trapping Season)

1) After locating stool specimen, make sure it can be identified as one of the desired species.

2) Fecal specimen should be fresh; if specimen is completely dried up do not place in vial, obtain diffent specimen.

3) Follow directions 2-4 above.

Appendix E

CONN. STATE DEPARTMENT OF HEALTH
LABORATORY DIVISION
P.O. Box 1689
HARTFORD, CONN. 06101

ANIMAL STOOL FOR GIARDIA SURVEY GS

TYPE OF ANIMAL: _____

WATERSHED: _____

LOCATION OF WATERSHED: _____

DATE COLLECTED: _____

Place a portion of feces about the size of a walnut in the vial. Break it up with the sticks provided.

Space below this line is for laboratory use.

_____

Date Received: Date Reported:

CONN. STATE DEPARTMENT OF HEALTH
LABORATORY DIVISION
P.O. Box 1689
HARTFORD, CONN. 06101

ANIMAL STOOL FOR GIARDIA SURVEY GS

TYPE OF ANIMAL: _____

WATERSHED: _____

LOCATION OF WATERSHED: _____

DATE COLLECTED: _____

Place a portion of feces about the size of a walnut in the vial. Break it up with the sticks provided.

Space below this line is for laboratory use.

_____

Date Received: Date Reported:

APPENDIX F

TABLE F1. RESULTS OF FECAL ANIMAL SURVEY WITH WATERSHED AREA, ANIMALS, NUMBER, AND PERCENT POSITIVE FOR GIARDIA.

WATERSHED	MUSKRAT	# POS.	DEER	# POS.	RACCOON	# POS.	SQUIRREL	#POS.	BEAVER	# POS.	TOTAL	#POS.	%POS.
West Hftd.													
MDC #5	14	0	3	0	20	0	5	0	0	0	42	0	0
MDC #6	10	1	15	0	8	0	4	0	4	0	41	1	2
Barkhamstead													
Bark. Res	25	0	22	0	23	0	2	0	44	0	116	0	0
Bridgeport													
Saugatuck River	15	3	7	0	5	0	1	0	0	0	28	3	10.7
Hemlock Res.	0	0	23	0	4	0	1	0	0	0	28	0	0
Aspetuck River	2	0	27	0	7	0	2	0	0	0	38	0	0
Newtown													
Taunton Pond	3	0	6	0	10	0	0	0	0	0	19	0	0
New Britain													
Wesel	2	0	0	0	6	0	1	0	0	0	9	0	0
Shuttle Meadow	0	0	0	0	10	1	3	0	0	0	13	1	7.7
Greenwich													
Mianus River	18	0	41	0	14	1	0	0	0	0	73	1	1.4
Stamford													
Stamford Res.	4	0	2	0	0	0	0	0	0	0	6	0	0
Total	93	4	146	0	107	2	19	0	48	0	413	6	1.45
Positive %	4.3%		0		1.9%		0		0		1.45%		

TABLE F2. ANIMAL FECAL SPECIMENS COLLECTED FROM MARCH 1980 TO OCTOBER 1980 BY: WATERSHED, ANIMAL, PERCENT POSITIVE FOR GIARDIA.

WATERSHED	MUSKRAT	# POS.	DEER	# POS.	RACCOON	# POS.	SQUIRREL	# POS.	BEAVER	# POS.	TOTAL	# POS.	% POS.
West Htfd.													
MDC #5	12	0	2	0	11	0	3	0	0	0	28	0	0
MDC #6	4	1	9	0	6	0	2	0	4	0	25	1	4
Barkhamstead													
Bark. Res.	22	0	19	0	13	0	2	0	40	0	96	0	0
Bridgeport													
Saugatuck	11	1	7	0	1	0	0	0	0	0	19	1	5.3
Hemlock	0	0	21	0	3	0	0	0	0	0	24	0	0
Aspetuck	0	0	23	0	6	0	2	0	0	0	31	0	0
Newtown													
Taunton Pond	0	0	0	0	0	0	0	0	0	0	0	0	0
New Britain													
Wesel	0	0	0	0	0	0	0	0	0	0	0	0	0
Shuttle Meadow	0	0	0	0	0	0	0	0	0	0	0	0	0
Greenwich													
Mianus River	11	0	29	0	14	1	0	0	0	0	54	1	1.85
Stamford													
Stamford Res.	4	0	2	0		0	0	0	0	0	6	0	0
Total	64	2	112	0	54	1	9	0	44	0	283	3	
% Positive		3.1%		0%		1.85%		0%		0%		1.1%	

TABLE F3. ANIMAL FECAL SPECIMENS COLLECTED FROM OCTOBER 1979 TO FEBRUARY 1980 BY: WATERSHED, ANIMAL NUMBER AND PERCENT POSITIVE FOR GIARDIA.

WATERSHED	MUSKRAT	# POS.	DEER	# POS.	RACCOON	# POS.	SQUIRREL	# POS.	BEAVER	# POS.	TOTAL	# POS.	% POS.
Barkhamstead													
Bark. Res.	3	0	3	0	10	0	0	0	4	0	20	0	0
Bridgeport													
Saugatuck Res.	4	2	0	0	4	0	1	0	0	0	9	2	22.2
Hemlock Res.	0	0	2	0	1	0	1	0	0	0	4	0	0
Aspetuck River	2	0	4	0	1	0	0	0	0	0	7	0	0
Newtown													
Taunton Pond	3	0	6	0	10	0	0	0	0	0	19	0	0
New Britain													
Wesel	0	0	0	0	6	0	1	0	0	0	7	0	0
Shuttle Meadow	0	0	0	0	10	1	3	0	0	0	13	1	7.7
Greenwich													
Mianus River	7	0	12	0	0	0	0	0	0	0	19	0	0
West Hftd.													
MDC #5	12	0	17	0	9	0	2	0	0	0	14	0	0
MDC #6	6.5	0	6	0	2	0	2	0	0	0	16	0	0
Total	27	2	34	0	53	1	10	0	4	0	128	3	2.34
% Positive	7.4%		0		1.9%		0		0		2.34%		

TABLE F4. RESULTS OF YEAST ANALYSES BY SAMPLE LOCATION WITH BACTERIOLOGICAL RESULTS AND *GIARDIA* RESULTS.

SAMPLE LOCATION	YEAST (TYPE & #)	COLIFORMS COLONIES TOTAL	FECAL	S.P.C.	TYPE OF SAMPLE	*GIARDIA* (-, +)
New Britain Filter Plant Shuttle Meadow Res.	*Candida tropicalis* 10 ml = 6 colonies	12	2.2	90	Raw	-
MDC Farmington Ave. Plant Res. #5	1 yeast in 10 ml sample 5 yeast in 100 ml sample	0	<2.2	3	Raw	-
Mianus River Filter Plant Mianus River	*Trichosporon capitatum* 6 colonies Candida tropicalis 6 colonies	450	>16	2000	Raw	-
New Britain Filter Plant Shuttle Meadow Res.	*Candida tropicalis* 100 ml = 1 colony	1	<2.2	48	Raw	-
New Britain Filter Plant Shuttle Meadow Res.	*Saccharomyces cerevisiae* 100 ml = 1 colony	2	2.2	120	Raw	-
Mianus River Filter Plant Mianus River	*Saccharomyces cerevisiae* 5 colonies *Candida lambica* 3 colonies	100	>16	440	Raw	-
Mianus River Filter Plant Mianus River	*Candida lambica* 1 colony	0	<2.2	0	Raw	-
MDC Route 44 Filter Plant Res. #6	*Candida humicola* 2 colonies	3	5.1	470	Treated	-
Taunton Pond	*Hanseniaspora uvarum* 10 ml = 1 colony 100 ml = 3 colonies	Not Sampled			Raw	-

TABLE F4 (continued).

SAMPLE LOCATION	YEAST (TYPE & #)	COLIFORMS COLONIES TOTAL	FECAL	S.P.C.	TYPE OF SAMPLE	GIARDIA (-, +)
Hemlock Reservoir Treatment Plant Hemlock Res.	Candida parapsilosis 100 ml = 1 colony	0	<2.2	3	Treated	-
Hemlock Reservoir Treatment Plant Hemlock Reservoir	Candida parapsilosis 100 ml = 3 colonies	Not Sampled			Raw	-
New Britain Filter Plant Shuttle Meados Ave.	Candida humicola 110 ml = 1 colony	17	2.2	160	Raw	-
New Britain Filter Plant Shuttle Meadow Ave.	Candida zeylanoides 10 ml = 6 colonies	0	<2.2	0	Treated	-
MDC Farmington Ave. Treatment Plant Res. #5	Hanseniaspora uvarum 1 colony	5	<2.2	62	Raw	-
Mianus River Filter Plant Mianus River	Hanseniaspora uvarum 1 colony	380	16	1600	Raw	-

10 ml = 10 ml sample tested
100 ml = 100 ml sample tested
S.P.C. = Standard Plate Count

TABLE F5. BACTERIOLOGICAL, PHYSICAL, AND GIARDIA RESULTS AT EACH SAMPLING SITE.

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+-)
MDC Water	Res #5	Raw	11/6/79	–	0	0	0	0	ND	ND	55	ND	
Comm , W Hftd			11/7/79	409	0	0	3	0	ND	7 4	55	1 1	-
Treat Plant		Treated	11/6/79		5	6	0	0	ND	ND	55	ND	
			11/7/79	453	5	5	0	0	ND	ND	54	1 4	-
	Res #6	Raw	11/6/79		0	0	17	1	ND	ND	55	ND	
			11/8/79	369 8	0	0	4	2	ND	ND	54	ND	-
		Treated	11/6/79		8	8	0	0	ND	7 0	57	ND	
			11/8/79	591 5	1 0	1 0	0	0	ND	7 3	58	4	
MDC Collins-	Nepaug	Treated	11/19/79		2 5	2 6	0	0	ND	7 1	48	2 2	
ville W Co	Barkhamstead		11/20/79	543	2 5	2 6	0	0	ND	7 1	49	ND	-
New Britain	Shuttle Meadow	Raw	11/19/79		0	0	28	3	ND	6 9	48	1 6	
Water Dept	Wesel, Whigville		11/20/79	418	0	0	20	30	ND	7 0	48	1 6	
	Res	Treated	11/19/791		3	4	0	0	ND	6 8	49	8	
			11/20/79	537	3	35	0	0	ND	7 1	50	7	
CT American	Mianus River	Raw	11/13/79		0	0	500	120	ND	7 3	50	ND	
Water Co			11/14/79	310	0	0	300	17	ND	7 3	50	1 5	
(Mianus River		Treated	11/13/79		95	95	0	0	ND	7 6	53	1 8	
Treat Plant)			11/14/79	551	09	95	3	0	ND	7 6	53	1 4	
Stamford Water	North Stamford	Treated	11/13/79		2 25	2 5	0	0	ND	7 2	53	3 5	
Co (N Stamford	Res		11/14/79	279	2 5	2 6	*	0	ND	7 4	53	4 1	-
Treat Plant)													
Newtown Water	Taunton	Treated	11/26/79		1 1	2 1	0	0	ND	7 3	54	2 0	
Co Town Hall	Pond		11/27/79	474	2 0	2 1	0	0	ND	7 2	54	2 6	-
Bridgeport	Aspatuck,	Treated	11/26/79		2 0	2 2	0	0	ND	7 4	48	1 4	
Hyd Co	Saugatuck,		11/27/79	622	2 1	2 3	0	0	ND	8 0	50	1 6	-
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water Comm (W Hftd Treat Plant)	Res #5	Raw	12/3/79		0	0	0	<22	10	LA	40	LA	
			12/4/79	399	0	0	2	<22	14	67	48	14	-
		Treated	12/3/79		5	6	0	<22	0	LA	50	LA	
			12/4/79	455	5	6	0	<22	72	72	48	10	
	Res #6	Raw	12/3/79		0	0	4	22	95	LA	48	LA	
			12/4/79	344	0	0	1	<22	1800	71	46	29	-
		Treated	12/3/79		9	10	0	<22	0	ND	53	ND	
			12/4/79	531	85	9	0	<22	0	71	52	15	-
MDC, Collinsville W Co	Nepaug Barkhamstead	Treated	12/4/79		19	20	0	<22	29	73	45	24	
			12/5/79	566	23	23	0	<22	24	74	45	25	-
New Britain W Dept	Shuttle Meadow Wesel, Whigville Res	Raw	12/26/79		0	0	18	9	170	74	37	17	
			12/27/79	412	0	0	25	>16	56	77	37	16	-
		Treated	12/26/79		25	-	0	<22	2	72	39	6	
			12/27/79	561	25	-	0	<22	0	78	39	7	
CT American Water Co (Mianus River Treat Plant	Mianus River	Raw	12/10/79		0	0	40	16	190	73	40	24	-
			12/12/79	437	0	0	28	>16	55	74	42	23	-
		Treated	12/10/79		13	15	0	<22	0	81	45	12	
			12/11/79	448	13	15	0	<22	1	72	50	19	-
Stamford Water Co (N Stamford Treat Plant)	North Stamford Res	Treated	12/10/79		27	27	0	<22	15	73	45	13	
			12/12/79	853	22	235	0	<22	12	73	46	22	-
Newtown W Co Town Hall	Taunton Pond	Treated	12/18/79		19	-	0	<22	2	ND	42	ND	
			12/19/79	193	14	-	0	<22	4	72	45	23	-
Bridgeport Hyd Co Hemlock Res	Aspatuck, Saugatuck, Hemlock Res	Treated	12/18/79		18	-	0	<22	12	69	42	23	
			12/19/79	400	19	-	0	<22	11	70	40	13	-

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	1/7/80		0	-	0	22	21	68	39	12	
Comm. (W. Hftd			1/9/80	803	0	-	0	< 22	11	74	39	14	-
Treat Plant		Treated	1/7/80		6	-	0	< 22	0	74	40	7	
			1/9/80	974	6	-	0	< 22	1	77	40	13	-
	Res #6	Raw	1/7/80		0	-	10	92	350	74	36	18	
			1/9/80	301	0	-	1	< 22	47	74	38	16	-
		Treated	1/7/80		9	-	0	< 22	0	72	42	5	
			1/9/80	939	7	8	0	< 22	1	72	42	11	-
MDC, Collins-	Nepaug	Treated	1/7/80		22	-	1	22	48	72	36	14	
ville W Co	Barkhamstead		1/9/80	652	19	-	0	< 22	35	75	36	15	-
New Britain	Shuttle Meadow	Raw	1/21/80		0	0	0	< 22	58	74	35	19	
W Dept	Wesel, Whigville		1/23/80	822	0	0	3	< 22	23	72	35	18	-
	Res	Treated	1/21/80		3	3	0	< 22	0	72	38	8	
			1/23/80	1203	25	25	0	< 22	0	72	38	7	-
CT American	Mianus River	Raw	1/29/80		0	0	500	16	170	77	35	23	
Water Co			1/31/80	630	0	0	32	ND	80	76	34	17	-
(Mianus River		Treated	1/29/80		10	11	0	< 22	0	77	40	8	
Treat Plant)			1/31/80	1405	13	15	0	ND	0	83	42	8	-
Stamford Water	North Stamford	Treated	1/29/80		22	23	0	< 22	14	74	40	16	
Co (N Stamford	Res		1/31/80	1245	19	21	0	ND	13	72	40	10	-
Treat Plant)													
Newtown W	Taunton	Treated	1/21/80		20	21	0	< 22	17	73	40	23	
Co Town Hall	Pond		1/23/80	1561	20	21	0	< 22	6	74	40	34	-
Bridgeport	Aspatuck,	Treated	1/29/80		20	21	0	< 22	6	74	40	34	
Hyd Co	Saugatuck,		1/31/80	1298	18	20	0	ND	23	72	35	11	-
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water Comm (W Hftd Treat Plant)	Res #5	Raw	2/6/80		0	0	0	< 2 2	16	7 0	38	9	
			2/7/80	340	0	0	0	5 1	22	7 0	38	1 1	-
		Treated	2/5/80		6	65	0	-	5	7 2	35	4	
			2/6/80	432	8	8	0	< 2 2	1	7 1	34	7	-
	Res #6	Raw	2/5/80		0	0	0	< 2 2	34	7 2	39	48	
			2/6/80	215	0	0	0	< 2 2	20	7 1	38	1 2	-
		Treated	2/5/80	B	85	85	0	< 2 2	0	7 2	40	3	
			2/6/80	M	85	90	0	< 2 2	1	7 1	40	4	-
MDC, Collinsville W Co	Nepaug Barkhamstead	Treated	2/5/80		1 7	1.8	0	< 2 2	27	7 3	35	.9	
			2/6/80	520	2 3	2 4	0	< 2 2	15	7 3	35	7	-
New Britain W Dept	Shuttle Meadow Wesel, Whigville Res	Raw	2/26/80		0	0	0	< 2 2	13	7 3	39	1 4	
			2/27/80	421	0	0	3	2 2	10	7 3	39	1 1	-
		Treated	2/26/80		2	2	0	< 2 2	2	7 3	40	7	
			2/27/80	607	2	2	0	< 2 2	1	7 3	40	1 2	-
CT American Water Co (Mianus River Treat Plant	Mianus River	Raw	2/19/80		0	0	0	> 16	310	7 9	34	1 3	
			2/20/80	342	0	0	39	ND	300	7 3	35	1 4	-
		Treated	2/19/80		1 0	1 0	0	< 2 2	1	7 4	39	4	
			2/20/80	605	1 1	1 1	0	ND	8	7 6	42	3	-
Stamford Water Co (N Stamford Treat Plant)	North Stamford Res	Treated	2/19/80	C	2 0	2 3	0	< 2 2	13	7 2	40	8	
			2/20/80	M	2 2	2 3	0	ND	28	7 0	40	7	-
Newtown W Co Town Hall	Taunton Pond	Treated	2/26/80		1 7	1 8	0	< 2 2	2	7 3	41	1 2	
			2/27/80	736	1 7	1 85	0	< 2 2	4	7 2	41	1 2	-
Bridgeport Hyd Co Hemlock Res	Aspatuck, Saugatuck, Hemlock Res	Treated	2/19/80		1 8	1 9	0	< 2 2	19	7 3	38	1 0	
			2/20/80	640	2 0	2 2	0	ND	30	7 2	38	1 0	-

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	3/17/80		0	0	0	< 2 2	120	7 1	38	1 8	
Comm (W Hftd			3/18/80	271	0	0	0	< 2 2	140	7 1	38	1 4	
Treat Plant)		Treated	3/17/80		7	7	0	< 2 2	0	7 2	39	1 2	
			3/18/80	490	7	7	0	< 2 2	0	7 2	38	7	
	Res #6	Raw	3/17/80		0	0	0	< 2 2	3000	6 9	39	2 3	
			3/18/80		0	0	4	< 2 2	100	7 0	40	2 0	
		Treated	3/17/80		8	85	0	< 2 2	LA	6 9	40	1 0	
			3/18/80	640	85	90	0	< 2 2	0	7 1	40	4	
MDC, Collins	Nepaug	Treated	3/17/80		2 0	2 1	0	< 2 2	11	7 2	39	1 3	
ville W Co	Barkhamstead		3/18/80	421	2 8	3 0	0	< 2 2	9	8 2	38	1 5	
New Britain	Shuttle Meadow	Raw	3/24/80		0	0	25	LA	LA	7 1	40	3 6	
W Dept	Wesel, Whigville		3/25/80	426	0	0	26	5 1	16	6 9	41	4 7	
	Res	Treated	3/24/80		25	25	0	LA	LA	7 2	41	9	
			3/25/80	615	2	25	0	< 2 2	2	6 4	43	6	
CT American	Mianus River	Raw	3/4/80		0	0	1	< 2 2	160	7 2	35	9	
Water Co			3/5/80	300	0	0	100	< 2 2	16	7 2	35	INS	
(Mianus River		Treated	3/4/80		1 0	1 0	0	< 2 2	1	7 1	40	4	
Treat Plant			3/5/80	741	9	1 0	0	< 2 2	1	7 6	41	5	
Stamford Water	North Stamford	Treated	3/4/80		2 3	2 5	0	< 2 2	0	6 8	40	1 5	
Co (N Stamford	Res		3/5/80	367	2 2	2 3	0	< 2 2	9	7 1	39	INS	
Treat Plant)													
Newtown W	Taunton	Treated	3/24/80		1 6	1 8	Sample Spilled				42		
Co Town Hall	Pond		3/25/80	835	9	1 0	0	< 2 2	3	6 7	42	2 6	
Bridgeport	Aspatuck,	Treated	3/4/80		1 6	1 7	0	< 2 2	14	6 7	40	7	
Hyd Co	Saugatuck,		3/5/80	673	1 7	1 8	0	< 2 2	22	7 0	40	INS	
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	4/1/80	-	0	0	0	< 2 2	170	7 0	43	2 2	
Comm (W Hftd			4/2/80	279	0	0	0	< 2 2	20	7 2	43	4 2	-
Treat Plant)		Treated	4/1/80		75	75	0	< 2 2	2	7 1	40	6	
			4/2/80	483	70	70	0	< 2 2	1	6 9	41	1 2	-
	Res #6	Raw	4/1/80		0	0	6	< 2 2	420	7 0	43	4 7	
			4/2/80	230	0	0	0	< 2 2	200	7 2	43	2 5	-
		Treated	4/1/80		95	95	0	< 2 2	0	6 9	43	9	
			4/2/80	623	80	85	0	< 2 2	1	6 9	43	1 0	-
MDC, Collins-	Nepaug	Treated	4/1/80		2 6	2 7	0	16	160	7 2	40	3 2	
ville W Co	Barkhamstead		4/2/80	492	2 7	2 7	0	< 2 2	190	8 0	40	2 4	-
New Britain	Shuttle Meadow	Raw	4/29/80		0	0	38	9 2	110	7 2	50	3 1	
W Dept	Wesel, Whigville		4/30/80	442	0	0	1	< 2 2	90	7 2	50	1 3	-
	Res	Treated	4/29/80		2	2	0	< 2 2	0	7 5	51	1 0	
			4/30/80		2	2	0	< 2 2	0	7 2	51	1 3	-
CT American	Mianus River	Raw	4/8/80		0	0	33	16	100	INS	48	1 9	
Water Co			4/9/80	345	0	0	0	< 2 2	2	7 2	50	1 4	-
(Mianus River		Treated	4/8/80		95	1 0	1	< 2 2	0	INS	49	6	
Treat Plant			4/9/80	750	1 0	1 1	0	< 2 2	39	7 0	52	3 4	-
Stamford Water	North Stamford	Treated	4/8/80		1/65	1 7	0	< 2 2	12	INS	45	1 4	
Co (N Stamford	Res		4/9/80	577	2 1	2 15	0	< 2 2	48	INS	46	1 5	-
Treat Plant)													
Newtown W	Taunton	Treated	4/29/80		1 8	1 8	0	< 2 2	1	7 2	55	1 6	
Co Town Hall	Pond		4/30/80	728	1 2	1 25	0	< 2 2	0	7, 2	53	2 0	-
Bridgeport	Aspatuck,	Treated	4/8/80		1 8	1 9	0	< 2 2	64	INS	45	1 6	
Hyd Co	Saugatuck,		4/9/80	638	1 8	1 8	50	16	170	7 1	44	1 9	-
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water Comm (W Hftd Treat Plant)	Res #5	Raw	5/6/80		0	0	1	<2 2	69	6 9	51	1 1	
			5/7/80	319	0	0	0	<2 2	3	6/7	52	1 3	-
		Treated	5/6/80		60	60	0	<2 2	2	7 4	53	9	
			5/7/80	525	65	65	0	<2 2	0	7 1	54	7	-
	Res #6	Raw	5/6/80		0	0	0	<2 2	91	7 2	55	2 2	
			5/7/80	91	0	0	2	<2 2	66	6 9	55	1 6	-
		Treated	5/6/80		75	75	0	<2 2	0	7 2	53	7	
			5/7/80	654	80	80	0	<2 2	38	6 9	53	5	-
MDC, Collinsville W Co	Nepaug Barkhamstead	Treated	5/19/80		1 9	1 95	0	<2 2	26	7 5	60	2 1	
			5/20/80	488	1 8	1 85	0	<2 2	22	7 5	59	2 4	-
New Britain W Dept	Shuttle Meadow Wesel, Whigville Res	Raw	5/19/80		0	0	1	<2 2	24	7 3	56	1 2	
			5/20/80	515	0	0	1	<2 2	48	7 6	54	1 9	
		Treated	5/19/80		2	25	0	<2 2	4	7 4	57	1 4	
			5/20/80	570	2	2	0	<2 2	0	7 4	56	1 0	-
CT American Water Co (Mianus River Treat Plant)	Mianus River	Raw	5/12/80		0	0	130	16	3400	7 2	55	2 0	
			5/13/80	389	0	0	450	16	2000	7 4	56	3 0	-
		Treated	5/12/80		85	90	0	<2 2	0	7 7	56	7	
			5/13/80	832	75	75	0	<2 2	3	7 5	61	5	-
Stamford Water Co (N Stamford Treat Plant)	North Stamford Res	Treated	5/12/80		2 2	2 3	0	<2 2	18	7 0	56	2 0	
			5/13/80	649	2 2	2 2	0	<2 2	4	7 1	57	2 8	
Newtown W. Co Town Hall	Taunton Pond	Treated	5/19/80		1 6	1 7	0	<2 2	4	7 4	60	2 3	
			5/20/80	434	1 5	1 5	0	<2 2	5	7 5	64	6 8	-
Bridgeport Hyd Co Hemlock Res	Aspatuck, Saugatuck, Hemlock Res	Treated	5/12/80		2 0	2 1	0	<2 2	47	7 2	56	2 4	
			5/13/80	696	1 8	1 9	0	<2 2	12	7 1	58	4 5	-

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	6/2/80	B	0	0	1	< 2 2	32	7 0	54	1 5	
Comm (W Hftd			6/3/80	M	0	0	2	< 2 2	30	6 9	56	1 5	-
Treat Plant)		Treated	6/2/80		7	7	0	< 2 2	0	7 2	61	1 0	
			6/3/80	472	7	7	0	< 2 2	1	7 3	62	6	-
	Res #6	Raw	6/2/80		0	0	0	< 2 2	100	7 0	64	2 0	
			6/3/80	213	0	0	1	< 2 2	94	7 0	64	1 5	-
		Treated	6/2/80		7	7	0	< 2 2	0	7 2	60	1 0	
			6/3/80	646	9	9	0	< 2 2	0	7 0	61	4	-
MDC, Collins-	Nepaug	Treated	6/23/80		1 5	1 5	0	< 2 2	7	7 2	66	1 6	
ville W Co	Barkhamstead		6/24/80	527	1 5	1 7	0	< 2 2	1	7 3	66	1 0	
New Britain	Shuttle Meadow	Raw	6/9/80		0	0	2	< 2 2	100	7 8	62	1 1	
W Dept	Wesel, Whigville		6/10/80	415	0	0	2	< 2 2	120	7 5	62	1 5	
	Res	Treated	6/9/80		25	25	0	< 2 2	0	7 7	62	7	
			6/10/80	554	25	25	0	< 2 2	16	7 6	62	1 3	-
CT American	Mianus River	Raw	6/16/80		0	0	230	16	1700	7 7	66	2 8	
Water Co			6/17/80	328	0	0	100	16	440	7 2	66	2 7	-
(Mianus River		Treated	6/16/80		65	70	0	< 2 2	1	8 1	67	3 1	
Treat Plant)			6/17/80	766	5	5	0	< 2 2	0	8 4	67	1 6	-
Stamford Water	North Stamford	Treated	6/16/80		2 5	2 6	0	< 2 2	1	7 5	67	1 6	
Co (N Stamford	Res		6/17/80	638	2 2	2 2	0	< 2/2	2	7 2	65	1 2	-
Treat Plant)													
Newtown W	Taunton	Treated	6/9/80		1 4	1 5	0	< 2 2	1	7 7	66	2 0	
Co Town Hall	Pond		6/10/80	366	1 4	1 5	0	< 2 2	0	7 5	65	2 0	-
Bridgeport	Aspatuck,	Treated	6/16/80		2 2	2 2	0	< 2 2	3	7 6	65	2 3	
Hyd Co	Saugatuck,		6/17/80	646	2 0	2 0	0	< 2 2	8	7 4	65	1 7	-
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	7/21/80		0	0	3	< 2 2	42	7 1	60	1 6	
Comm (W Hftd			7/22/80	308	0	0	0	< 2 2	0	7 1	62	1 7	-
Treat, Plant		Treated	7/21/80		75	75	0	< 2 2	1	7 6	68	1 0	
			7/22/80	398	65	70	0	< 2 2	0	7 6	70	1 1	-
	Res #6	Raw	7/21/80		0	0	24	< 2 2	61	7 2	74	INS	
			7/22/80	244	0	0	10	< 2 2	110	7 4	74	1 6	-
		Treated	7/21/80		7	7	0	< 2 2	0	7 0	70	1 0	
			7/22/80	694	8	85	0	< 2 2	0	7 3	71	1 1	-
MDC, Collins-	Nepaug	Treated	7/28/80		1 85	1 9	0	< 2 2	0	7 2	78	1 6	
ville W Co	Barkhamstead		7/29/80	503	1 9	1 9	0	< 2 2	1	7 4	78	8	-
New Britain	Shuttle Meadow	Raw	7/14/80		0	0	36	< 2 2	370	7 0	66	1 8	
W Dept	Wesel, Whigville		7/15/80	568	0	0	84	< 2 2	21	7 5	67	7 5	-
	Res	Treated	7/14/80		2	2	0	< 2 2	1	7 2	67	1 3	
			7/15/80	687	25	25	0	< 2 2	0	7 4	68	1 0	
CT American	Mianus River	Raw	7/7/80		0	0	300	16	6000	7 5	68	3 3	
Water Co			7/8/80	358	0	0	0	< 2 2	0	7 3	68	3 7	-
(Mianus River		Treated	7/7/80		35	40	0	< 2 2	0	8 2	73	1 0	
Treat Plant			7/8/80	821	8	8	0	< 2 2	0	8 2	71	1 0	-
Stamford Water	North Stamford	Treated	7/7/80		2 3	2 35	1	< 2 2	2	7 7	70	1 4	
Co (N Stamford	Res		7/8/80	647	2 0	2 1	0	< 2 2	0	7 1	70	2 8	-
Treat Plant)													
Newtown W	Taunton	Treated	7/28/80		1 5	1 5	0	< 2 2	0	7 4	78	1 7	
Co Town Hall	Pond		7/29/80	709	2 1	2 2	0	< 2 2	0	7 4	77	1 8	-
Bridgeport	Aspatuck,	Treated	7/7/80		2 0	2 1	0	< 2 2	5	7 4	65	1 8	
Hyd Co	Saugatuck,		7/8/80	674	1 8	1 9	0	< 2 2	3	7/3	66	1 3	-
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	8/18/80	-	0	0	CG	< 2 2	61	6 6	62	1 4	
Comm (W Hftd			8/19/80	369	0	0	0	< 2 2	0	7 2	61	5	-
Treat Plant)		Treated	8/18/80		6	65	0	< 2 2	1	7 1	65	1 0	
			8/19/80	445	6	6	0	< 2 2	85	6 2	66	1 3	-
	Res #6	Raw	8/18/80	8	0	0	CG	< 2 2	310	6 9	74	2 2	
			8/19/80	M	0	0	LA	LA	LA	7 1	73	9	-
		Treated	8/18/80		6	6	0	< 2 2	1	7 0	71	3 5	
			8/19/80	601	6	6	3	5 1	470		72	1 2	-
MDC, Collins-	Nepaug	Treated	8/18/80		2 2	2 2	0	< 2 2	2	7 0	74	1 1	
ville W Co	Barkhamstead		8/19/80	557	2 0	2 0	0	< 2 2	1	7 2	74	1 2	-
New Britain	Shuttle Meadow	Raw	8/11/80		0	0	1	< 2 2	780	7 7	71	1 9	
W Dept	Wesel, Whigville		8/12/80	458	0	0	0	< 2 2	920	-	62	-	-
	Res	Treated	8/11/80		35	35	0	< 2 2	2 2	7 6	72	1 1	
			8/12/80	548	35	4	0	< 2 2	0	7 6	68	1 1	-
CT American	Mianus River	Raw	8/4/80		0	0	750	16 0	-	7 7	73	2 2	
Water Co			8/5/80	334	0	0	500	16 0	-	7 7	75	2 3	
(Mianus River		Treated	8/4/80		65	65	0	< 2 2	0	7 9	75	1 0	
Treat Plant)			8/5/80	777	70	75	0	< 2 2	-	7 9	77	1 0	
Stamford Water	North Stamford	Treated	8/4/80		2 1	2 2	0	< 2 2	7	7 6	74	1 5	
Co (N Stamford	Res		8/5/80	591	2 5	2 7	0	< 2 2	-		75		
Treat Plant)													
Newtown W	Taunton	Treated	8/11/80		1 2	1 3	1	< 2 2	2 2	7 7	78	2 0	
Co Town Hall	Pond		8/12/80	390	1 35	1 4	LA	LA	LA	LA	LA	LA	
Bridgeport	Aspatuck,	Treated	8/4/80		2 0	2 0	0	< 2 2	-	7 6	70	1 4	
Hyd Co	Saugatuck,		8/5/80	653	1 85	2 0	0	< 2 2	-	7 7	70	1 6	-
Hemlock Res	Hemlock Res												

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water Comm (W Hftd Treat Plant)	Res #5	Raw	9/9/80	-	0	0	2	< 2 2	48	6 8	63	9	
			9/10/80	352	0	0	0	< 2 2	41	6 6	62	1 1	-
		Treated	9/9/80		8	8	0	< 2 2	0	7 2	66	-	
			9/10/80	417	7	7	0	< 2 2	0	7 2	67	9	-
	Res #6	Raw	9/9/80		0	0	12	16	190	7 1	72	1 8	
			9/10/80	255	0	0	2	< 2 2	230	7 6	73	1 5	-
		Treated	9/9/80		7	75	0	< 2 2	0	7 1	71	7	
			9/10/80	582	6	6	0	< 2 2	1	6 8	72	8	-
MDC, Collinsville W Co	Nepaug Barkhamstead	Treated	9/2/80		1 5	1 7	0	< 2 2	890	7 6	75	-	
			9/3/80	617	1 0	1 0	0	< 2 2	920	-	76	1 1	-
New Britain W Dept	Shuttle Meadow Wesel, Whigville Res	Raw	9/22/80		0	0	0	< 2 2	350	7 8	69	2 1	
			9/23/80	513	0	0	17	< 2 2	160	7 8	70	2 4	
		Treated	9/22/80		25	3	0	< 2 2	1	7 8	70	6	
			9/23/80	571	25	25	0	< 2 2	0	8 0	70	5	-
CT American Water Co (Mianus River Treat Plant)	Mianus River	Raw	9/15/80		0	0	17	16	1400	7 7	70	9	
			9/16/80	162	0	0	380	16	1600	7 6	68	1 4	-
		Treated	9/15/80		7	7	0	< 2 2	0	8 0	72	5	
			9/16/80	744	7	8	0	< 2 2	0	8 1	72	8	-
Stamford Water Co (N Stamford Treat Plant)	North Stamford Res.	Treated	9/15/80		2 4	2 4	0	< 2 2	1	7 5	72	1 9	
			9/16/80	604	2 2	2 3	0	< 2 2	4	7 6	72	1 4	-
Newtown W Co Town Hall	Taunton Pond	Treated	9/2/80		1 8	1 9	0	< 2 2	1	7 8	78	2 3	
			9/3/80	372	1 5	1 5	0	< 2 2	2	7 5	77	2 2	
Bridgeport Hyd Co Hemlock Res	Aspatuck, Saugatuck, Hemlock Res	Treated	9/15/80		1 9	2 0	0	< 2 2	2	7 6	70	2 0	
			9/16/80	645	1 9	2 0	0	< 2 2	3	7 7	69	1 0	-

TABLE F5 (continued).

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	GAL.	CHLORINE (mg/l) FREE	CHLORINE (mg/l) TOTAL	COLIFORMS TOTAL	COLIFORMS FECAL	S.P.C.	pH	TEMP °F	TURB	GIARDIA (+,-)
MDC Water	Res #5	Raw	10/27/80	C	0	0	3	< 2 2	87	7 1	55	9	
Comm (W Hftd			10/28/80	M	0	0	5	< 2 2	62	7 2	55	9	-
Treat Plant)		Treated	10/27/80		7	7	0	< 2 2	1	7 6	57	7	
			10/28/80	451	7	7	0	< 2 2	0	7 6	56	4	-
	Res #6	Raw	10/27/80		0	0	7	< 2 2	250	7 2	55	2 7	
			10/28/80	179	0	0	11	< 2 2	130	7 0	54	1 3	-
		Treated	10/27/80		8	8	0	< 2 2	2	7 9	60	8	
			10/28/80	554	8	85	0	< 2 2	0	6 6	59	3	-
MDC, Collins-	Nepaug	Treated	10/27/80		2 1	2 2	0	< 2 2	8	7 6	51	1 5	
ville W Co	Barkhamstead		10/28/80	569	2 3	2 3	0	< 2 2	5	7 4	52	1 2	-
New Britain	Shuttle Meadow	Raw	10/20/80		0	0	200	16	-	7 5	59	1 4	
W Dept	Wesel, Whigville		10/21/80	377	0	0	400	16	470	8 0	58	2 9	-
	Res	Treated	10/20/80	-	3	35	0	< 2 2	0	7 5	60	7	
			10/21/80	572	4	4	0	< 2 2	0	8 0	59	7	-
CT American	Mianus River	Raw	10/6/80		0	0	480	16 0	1200	-	59	1 5	
Water Co			10/7/80	300	0	0	230	16 0	720	-	58	2 0	-
(Mianus River		Treated	10/6/80		1 1	1 1	0	< 2 2	2	-	68	4	
Treat Plant)			10/7/80	738	1 1	1 1	0	< 2 2	1	-	64	5	-
Stamford Water	North Stamford	Treated	10/6/80		2 2	2 2	0	< 2 2	3	-	66	1 1	
Co (N Stamford	Res		10/7/80	593	2 1	2 2	0	< 2 2	2	-	64	1 9	-
Treat Plant)													
Newtown W	Taunton	Treated	10/20/80		6	7	0	< 2 2	-	7 2	62	1 6	
Co Town Hall	Pond		10/21/80	57	2 3	2 4	0	< 2 2	0	7 6	60	1 2	-
Bridgeport	Aspatuck,	Treated	10/6/80		1 9	1 9	0	< 2 2	0	-	64	7	
Hyd Co	Saugatuck,		10/7/80	638	1 9	2 0	0	< 2 2	1	-	64	8	-
Hemlock Res	Hemlock Res												

ND = Not done
LA = Lab accident
B = Broken
M = Meter
C = Clogged
INS = Insufficient Sample
CG = Confluent growth

TABLE F6. WATER QUALITY RESULTS OBSERVED DURING THE MONTH THAT GIARDIA WERE FOUND IN ANIMAL FECAL SAMPLES.

SAMPLE SITE UTILITY	SOURCE	TYPE OF SAMPLE	DATE	COLIFORM TOTAL	COLIFORM FECAL	S.P.C.	TURB.	pH	TEMP °C	GIARDIA POSITIVE SAMPLE TYPE OF ANIMAL AND DATE COLLECTED
Bridgeport Hyd Co Hemlock Res.	Aspatuck Saugatuck Hemlock Res	Treated	11/26/79	0	0	ND	1 4	7 4	8 9	2 muskrat fecal samples collected 11/79
			11/27/79	0	0	ND	1 6	8 0	10	
New Britain Water Dept.	Shuttle Meadow Wesel, Whigville	Raw	12/26/79	18	9	170	1 7	7 4	2 8	1 raccoon fecal sample collected on 12/79
			12/27/79	25	16	56	1 6	7 7	2 8	
		Treated	12/26/79	0	< 2 2	2	6	7 2	3 9	
			12/27/79	0	< 2 2	0	7	7 8	3 9	
Bridgeport Hyd Co HEMLOCK Res	Aspatuck Saugatuck Hemlock	Treated	1/29/80	0	< 2 2	6	3 4	7 4	5 5	1 muskrat fecal sample collected on 1/80
			1/31/80	0	ND	23	1 1	7 2	1 7	
MDC Water W Hftd Treatment Plant	Res. #6	Raw	7/21/80	24	< 2 2	61	INS	7 2	23 3	1 muskrat fecal sample collected on 7/80
			7/22/80	10	< 2 2	110	1 6	7 4	23 3	
		Treated	7/21/80	0	< 2 2	0	1 0	7 0	21 1	
			7/22/80	0	2 2	0	1 1	7 3	21 7	
CT American Water Co	Mianus River	Raw	6/16/80	230	16	1700	2 8	7 7	18 9	1 raccoon fecal sample collected on 6/80
			6/17/80	100	16	440	2 7	7 2	18 9	
Mianus River Treatment Plant		Treated	6/16/80	0	<2 2	1	3.1	8 1	19 4	
			6/17/80	0	<2 2	0	1 6	8 4	19 4	

ND = Not Determined on Sample
INS = Insufficient Sample
S P C = Standard Plate Count
TURB = Turbidity